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CITY OF MANCHESTER.

Rivers Department.

ANNUAL REPORT

FOR THE

Year ending March 25th, 1931.

Price: Three Shillings and Sixpence.

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City of Manchester.

RIVERS DEPARTMENT.

Annual Report

FOR THE

YEAR ENDING MARCH 25th, 1931.

Rivers Department,
Ship Canal House,
King Street,
Manchester.

MEMBERS OF THE RIVERS COMMITTEE,

1930-1931.

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DEPUTY-CHAIRMAN—Councillor S. P. Dawson, M.M.

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(The Right Honourable George Frank Titt).

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WILLIAM PORTHOUSE. SECRETARY—George F. Walter, F.C.I.S.

SEWAGE WORKS MANAGER—Charles H. Ball.

RESIDENT CHEMIST—Clarence Jepson, M.SC., A.I.C.

RESEARCH CHEMIST—William T. Lockett, M.SC.

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CITY OF MANCHESTER.

Rivers Department.

Annual Report for the Year ending March 25th, 1931.

The Rivers Committee submit to the Council the following report on the work of the Rivers Department :—

Introductory.

The duties of the Rivers Committee are defined in the Council's Instructions to Committees, as follows :—

" To enforce and carry out the provisions of any public or local Act, or any legal remedy with respect to the rivers, brooks, or streams, wholly or partially within the City, and with respect to all other matters connected therewith ;

" That the said Committee be authorised and instructed to carry out and complete the Manchester Main Drainage Scheme, including all works in relation thereto, and for those purposes to exercise the powers of the Corporation under the Public Health Acts ;

" Also to execute the powers and duties of the Council with respect to the Sewage Outfall and Main Drainage Works of the Corporation under paragraph 2 (2) of the Fifth Schedule of the Manchester Corporation (General Powers) Act, 1904 (Chorlton-cum-Hardy Sewage Works to be used only for the three Withington Wards and the Urban District of Levenshulme as then defined) ; Part IV. (Sewerage) of the Manchester Corporation Act, 1908 ; Part V. (Sewerage) of the Manchester Corporation Act, 1909 ; Part IV. (Main Drainage Works) (except section 50) of the Manchester Corporation Act, 1911 ; Part VI. (Sewerage) of the Manchester Corporation Act, 1920 ; Part VIII. (Main Drainage) of the Manchester Corporation Act, 1924 ; and under any other local enactment ; also the provisions as to the discharge of certain matters into sewers, contained in section 21 of the Manchester Corporation (General Powers) Act, 1902, and the orders thereunder ; also to carry out and enforce the provision enabling the Corporation to define the boundaries of rivers, brooks, and watercourses contained in section 55 of the Manchester Corporation Act, 1911 ;

" Also to carry out the powers and duties of the Council under the following portions of the Manchester Corporation Act, 1914, viz. :—Part VI. (Main Drainage Works) and the following sections of Part VIII. (Miscellaneous), viz. :—Sections 48 (Maintenance and repair of banks of River Mersey), 50 (Watercourses not to be

covered in except in accordance with approved plan), 51 (Chemical refuse, steam, etc., not to be turned into culverted watercourse), 52 (Owners to repair and cleanse culverts), 53 (Corporation may define levels of rivers, brooks, and watercourses), 54 (Removal of weirs), 55 (Exemption of Canals), 71 (For protection of the Stretford Gas Company), 72 (2) (For protection of the Cheshire Lines Committee), 73 (For further protection of the Trafford Power Company), Sub-sections (16), (18), and (19) of section 74 (For protection of Manchester Ship Canal Company), and Section 76 (For protection of Lord Egerton's Trustees) ;

" Also to direct and manage the powers, authorities, and duties of the Council under the Rivers Pollution Prevention Acts, 1876 and 1893, section 14 of the Local Government Act, 1888, and sections 16, 17, and 47 of the Public Health Acts Amendment Act, 1890 ;

" Also to carry out and enforce the following provisions contained in the Public Health Act, 1925 :—

Section 40 (Power to require specially enlarged sewer in new street). (In common with the Paving, Sewering, and Highways Committee and the Improvement and Buildings Committee.)

Section 41 (Prevention of entry of petrol, etc., into sewer). (In common with the Public Health Committee and the Paving, Sewering, and Highways Committee.)

Section 51 (Power to require the covering in of watercourses and ditches). (In common with the Paving, Sewering, and Highways Committee and the Improvement and Buildings Committee.)

Sections 54 (Watercourse choked up to be a nuisance under the Public Health Act, 1875), and 55 (Power of local authority to defray cost of or execute works). (In common with the Paving, Sewering, and Highways Committee and the Public Health Committee) ;

" And that the said Committee shall have, and this Council hereby delegate to the said Committee, all and every the powers, authorities, and discretion which, by the said Acts, in relation to the matters and purposes aforesaid, are now given to, or vested in, this Council ;

" And the said Committee are hereby authorised to carry out the instructions heretofore given to the Rivers Committee, or which may, from time to time, be given to the said Committee by this Council."

Recent Main Drainage.

The total length of sewers constructed and completed to date is 27·16 miles, viz. :—Manchester Main Drainage Scheme 24·09 miles, under the Manchester Corporation Act, 1908, 0·93 miles, and to the relief of flooding in Moss Side and Whalley Range 2·14 miles, of which 4·50 miles were executed by the Committee's staff without the intervention of a contractor.

The sewers vary in size from 2·25 ft. to 15·25 ft. in diameter. They are constructed with red engineering bricks and shale bricks set in cement mortar. No surface clay bricks have been used.

Owing to the presence of water in the subsoil, considerable lengths of sewer have had to be executed under air pressure. The completed sewers pass beneath the London, Midland, and Scottish, the London and North Eastern, the Manchester, South Junction, and Altrincham, and the Cheshire Lines Committee Railways in seventeen places, and cross the Bridgewater Canal in seven places.

Sewage Disposal.

The Rivers Committee control the admission of all trade effluents into the sewers, according to the provisions of the before-mentioned Acts, and a special Inspector has charge of this work.

The main activity of the Committee is, however, connected with the disposal of the City sewage.

With the exception of the sewage from the Withington district, which receives treatment at the Withington Works, Chorlton-cum-Hardy, the whole of the City sewage is dealt with at the main outfall works at Davyhulme.

In addition, the sewage from the Borough of Middleton and from the parish of Davyhulme, together with some portions of the sewage from the Audenshaw, Droylsden, Great and Little Heaton, Royton, and Stretford areas, also passes to the Davyhulme works. A portion of the old Moss Side works at Urmston is still retained for the treatment of storm-water only, and the Middleton sewage works have been reconstructed to provide for the treatment of a certain proportion of the storm-water from this district.

Expenditure.

The following statements show in summarised form the details of the Committee's expenditure for the year under review :—

The total charge on the rates in respect of the work of the Committee was £233,064 2s. 5d.

Of this amount, a sum of £55,847 13s. 11d. was required for the upkeep of the Davyhulme, Withington, Moss Side, Middleton, and Gorton Sewage Works, and for general rivers work, comprising the administration at the Central Office, Ship Canal House, the cost of labour and various rivers improvements, contribution to the Mersey and Irwell Joint Committee, etc.

The remainder, amounting to £177,216 8s. 6d., was applied in the payment of interest on loans and repayment of debt on the capital outlay on intercepting sewers throughout the whole of the City, and on the purification plant at the various sewage works.

The details are as follow :—

	£	s.	d.	£	s.	d.
Administration and Upkeep.						
Davyhulme Sewage Works ..	*45,158	8	3			
Withington	6,948	3	2			
Moss Side	82	2	0			
Gorton	344	15	7			
Middleton	118	12	3			
Rivers Account	2,936	3	7			
Main Drainage Scheme	259	9	1			
				55,847	13	11
Interest on Loans and Repayment of Debt.						
Manchester	†68,074	4	6			
Withington	6,594	12	9			
Moss Side	0	0	0			
Gorton	106	2	3			
Middleton	172	0	9			
Rivers Account	‡4,547	6	3			
Main Drainage Scheme	97,722	2	0			
				177,216	8	6
Total				£233,064	2	5

* This amount represents the net cost to Manchester after deducting contributions from Audenshaw, Stretford, Barton, and Middleton Authorities (see Table IV. footnote).

† Included in this figure is a sum of £31,000 (approximately), the annual charge on the capital outlay on the Manchester Sewers (apart from the Main Drainage Scheme, 1911), amounting to £627,091, and certain payments in respect of the Middleton Sewage Works.

‡ The whole of the outstanding debt on this account has been liquidated by this payment.

Northenden Sewage.

Towards the end of the year under review preliminary arrangements were undertaken with a view of taking control of the Northenden Sewage Works on the extension of the City on April 1st, 1931. These works are situated on the banks of the River Mersey below Northenden Bridge, and provide for treatment of the sewage by screens, sedimentation tanks, sprinkling filters, and humus tank. A small subsidiary plant at Heyhead, near the southern boundary of the added districts, treating the sewage from an isolated colony of houses, will also have to be administered by the Department. A full description of the two plants will be given in the next report.

Wythenshawe Sewage.

In accordance with powers conferred by the Manchester Extension Act, 1930, a complete scheme has been adopted for the main drainage of the parishes of Northenden, Baguley, and Northen Etchells, districts which became a part of the City on the 1st April, 1931. Considerable progress had been made with the works at the date of this report.

Cheadle and Gatley Sewage.

During the year the Cheadle and Gatley Urban District Council have served the first notice under the Manchester Extension Act, 1930, section 68, requiring the Corporation to make the new sewer under the River Mersey, from the junction of Wythenshawe Road and Longley Lane to the existing sewer in Barlow Moor Road, of sufficient size to convey the sewage of the Urban District to the Corporation Sewage Disposal Works at Davyhulme.

Brooks's Drain.

A conference has taken place with other authorities concerned regarding the condition of the Brooks's Drain, an old culvert running partly through that portion of the Bucklow Rural District Council added to the City on the 1st April, 1931. The drainage of certain houses in the Baguley area is discharged into the drain, and the Corporation has expressed willingness to fall in with any reasonable scheme put forward by the Sale and Bucklow Councils, and also to withdraw foul sewage provided that the space vacated is not afterwards utilised by the Bucklow Rural District Council. Negotiations are proceeding at the date of this report.

Maintenance of Rivers and Streams.

The work of the river men has been distributed as follows :—

River Medlock.

	Days
Between Holt Town and Pin Mill	19
,, Pin Mill and Fairfield Street	29
,, North Western Street Tunnel and Mayfield ..	36
,, Hanover Mills and Jackson Street	18
,, Westhead's Weir and Brook Street	42
,, Charles Street and Birley's Weir	23
Cornbrook, Crowcroft Brook, Nico Ditch, etc.	10

Westhead's Weir.

Drawing weir and impounding water at week-ends ..	18
Attending sluices during floods	35
Clearing obstructions, repairs, etc.	30

Green Lane Depot.

Repairing waders and tackle, breaking up debris, lime-washing, and general work at Mess House	49
Assisting Rivers Inspector in examinations of trade waste entering sewers, and general rivers work..	262

Infringements of Manchester Corporation Acts, 1869, 1871, 1884, etc.

Twenty-seven cases of infringement of these Acts have been dealt with.

The subjects of complaint have been the tipping on river banks within reach of floods, the placing of obstructions in waterways, and the casting of solids into streams.

On several occasions resort to legal notice was required, but generally compliance with the requirements of the Corporation was obtained without difficulty. In some instances the work required was done by the river men at the cost of the owners.

Trade Refuse entering Sewers.

Numerous inspections of trade effluents entering sewers and of the flow in sewers have been made where discharges of an objectionable nature are liable to occur, and representations have been made to certain manufacturers with a view to the exclusion of discharges which are regarded by the Corporation as of an improper character.

The effluents to which objection has been taken are such as contain excessive quantities of suspended solids, acids, and sulphides.

Floods.

On the 5th July, 1930, a moderately heavy flood occurred in the River Medlock, when the heights given below were recorded :—

	ft.	in.
Pin Mill Bridge	7	6
Helmet Street Tunnel	7	9
Fairfield Street Bridge	8	1
Hoyle Street Bridge	8	0
Mayfield Tunnel	7	7
Downing Street Bridge	7	8
Jackson Street Bridge	7	3
Green Lane Yard	8	8
Brook Street Bridge	8	4
Oxford Road Bridge	6	10
Birley's Tunnel	6	2
Birley's Weir (on sill)	4	1
City Road Bridge	6	1
Knott Mill Weir (on sill)	4	7

Plans Approved.

During the year plans have been submitted to the Rivers Committee for the following, viz. :—

Ley Brook	Diversion and culverting at Withington.
	Diversion and culverting at Withington (No. 2).
Cringle Brook	Culverting at Burnage.
Ball Brook	Culverting at Kingsway, Didsbury.
Singleton Brook ..	Surface water connection for the Prestwich Urban District Council.

Proposed Straightening of the River Mersey.

A joint proposal of the Lancashire and Cheshire County Councils was submitted to the Rivers Committee for the straightening and by-passing of the River Mersey at Flixton and the formation of a joint authority for the future surveillance and control of the river from the weir at Northenden to the Manchester Ship Canal. With the object of facilitating the passage of flood water and checking bank erosion in the Mersey valley, it was proposed to cut a number of by-passes to short-circuit existing slack water loops and relieve flood pressure on the acute bends in the river's present course. One of the by-passes was to cut

across land belonging to the Rivers Department at Flixton, which has recently been drained and conditioned, and is now being used for sludge disposal. The matter was under the consideration of the Rivers Committee when the Land Drainage Act of 1930 was passed, and the proposal of the County Councils was thereupon abandoned, it being considered to come within the powers of the Catchment Board constituted by the Act.

Rivers Mersey and Irwell Catchment Board.

In August, 1930, the Land Drainage Act of 1930 received the Royal Assent. By virtue of the first Schedule (Part I.) of this Act the area of land drained by the River Mersey (above Irlam Weir) and the River Irwell (above Hunt's Bank, Manchester) became a "catchment area." The joint body responsible for the administration of the Act in the drainage area was constituted under the Rivers Mersey and Irwell Catchment Board Constitution Order of the Minister of Agriculture and Fisheries dated 5th February, 1931. The Board consists of twenty-two members, and to the five seats allotted to the Manchester Corporation under the Order of the Minister the City Council have elected the Chairmen and Deputy-Chairmen of the Agricultural and Rivers Committees and the City Engineer.

The Treatment of Sewage at the Withington Works.

Description of Works.

These works came under the control of the Rivers Committee upon the inclusion of the Withington Urban District Council District within the City on November 9th, 1904. They are situate at Chorlton-cum-Hardy, at the extreme western corner of the district, and are bounded by the River Mersey on two sides—south and west—the Chorlton Brook on the north, and an embankment on the east.

These works were originally designed to purify the sewage by treatment on the land. Subsequently a sedimentation tank and double-contact filter plant was installed as follows:—Two detritus tanks (capacity 83,400 gallons), two sedimentation tanks (capacity 781,000 gallons), ten first contact beds (2,900 superficial yards each), ten second contact beds (2,900 superficial yards each), and an area of storm beds of 12,452 superficial yards divided into four plots measuring respectively 2,882, 3,533, 3,751, and 2,286 superficial yards. A conical catch-pit in connection with the high-level sewer was constructed later (*cf.* report for the year ending March, 1911). In 1914 two Emscher (double-decked) tanks were constructed of sufficient capacity to deal with from 600,000 to 700,000 gallons per day, a general description of which appeared in the report for the year ending March, 1915.

A continuous-flow unit for the treatment of the sewage by the activated-sludge process was brought into operation in October, 1917, and occupies one-third of one of the above-mentioned sedimentation tanks. A complete account of this plant, together with plan, was given in the Annual Report for the year ending March, 1918.

An additional larger activated-sludge unit was brought into commission in August, 1923, and occupies one-third of one of the original second contact beds. A complete description of this installation was given in Appendix I. to the report for the year ending March, 1924 ; a plan of the same appeared in the Annual Report for the year ending March, 1923.

A general plan showing the arrangement of the present works appeared in the Annual Report for the year ending March, 1923.

The land is practically level throughout ; consequently it was found necessary, in order to carry out the scheme of double-contact beds, to raise the sewage at the outfall works, and, in order to avoid pumping the whole, to arrange the new outfall main sewers to gravitate the sewage of the upper zone of the district and the whole of the Levenshulme sewage, leaving only that from Didsbury and Chorlton-cum-Hardy to be pumped.

With the River Mersey and Chorlton Brook at ordinary level, the effluent is passed into the latter at a point some 300 yards above its junction with the Mersey ; but when the river and brook are in flood it is passed by a syphon under the Chorlton Brook into the Ousel Brook at a point near the Stretford Cemetery, and about half a mile below the Sewage Works. In addition to this, there is a storm-water reservoir nine acres in area for impounding storm water from the Chorlton-cum-Hardy district, as well as a portion of the effluent from the works. When the River Mersey is about its normal level this storm-water reservoir is discharged by gravitation into the river ; but should the river be in flood, it is then pumped by means of a suction-gas pumping installation.

In connection with the present main drainage scheme, arrangements have been made whereby the sewage from Levenshulme and Mauldeth Road can be diverted either to the Withington Works or into the main City outfall.

Since 29th November, 1928, approximately 750,000 gallons per day have been diverted to the Davyhulme Works.

The total population (Withington and Levenshulme) at present connected with the works is *64,000.

* This figure has been adjusted to meet the continued diversion of a portion of the sewage flow to Davyhulme.

The average daily flow of sewage (including storm water) for the year under observation amounted to 3,659,000 gallons, or 57 gallons per head of population per day.

With the exception of the suction gas plant referred to above, the whole of the power used on the works is now derived from the Corporation Electrical Supply.

The plant in the engine room comprises four centrifugal pumps for lifting the low-level sewage, air compressor for delivering the sludge through mains on to the land, and air compressors for the operation of the activated-sludge installations, all driven from electric motors of from 15 to 60 H.P.

In addition, there are small motors attached to screens placed on high and low-level sewers, and for driving chopping machine.

Area of Land.

The total area of land comprising the Withington Sewage Works amounts to 92·5 acres, and is divided up as follows :—

	Acres.
Land occupied by detritus, sedimentation, and activated-sludge tanks	2·25
Land occupied by buildings and sludge tank	
Land occupied by lay-byes and storage	
Land occupied by storm-water reservoir	9
Land occupied by bacteria beds	11·75
Land occupied by storm-water filters	2·5
Total area of land occupied	25·5
The area of land not occupied by bacteria beds, storm-water filters, buildings, tanks, etc., but under cultivation	67·0
Grand total	92·5

Of the land not utilised for sewage treatment an area of 21½ acres has again been let for a portion of the year as grazing land, an income of £69 17s. 6d. having been received.

Volume of Sewage Treated.

The volume of sewage actually delivered at these works is estimated at 1,331,703,000 gallons, an average of 3,659,000 gallons per day. The details of the flow, together with the volume in terms of per head of population and rainfall records, are given in the following table :—

Sewage Flows.

Period of 4 weeks ending	Total flow.	Average daily flow.	Average daily flow.	Rainfall.
	Gallons.	Gallons.	Gallons per head.	Inches.
1930 April 23rd	88,122,000	3,147,000		1·42
May 21st	84,062,000	3,002,000		1·58
June 18th	75,963,000	2,713,000		1·12
July 16th	75,677,000	2,703,000		1·15
August 13th	132,826,000	4,744,000		7·95
September 10th......	93,945,000	3,355,000		3·26
October 8th	103,944,000	3,712,000		3·79
November 5th	110,369,000	3,942,000		3·52
December 3rd	114,043,000	4,073,000		3·08
December 31st	104,362,000	3,727,000		2·75
1931 January 28th.........	118,964,000	4,249,000		3·74
February 25th	128,405,000	4,586,000		3·33
March 25th	101,021,000	3,608,000		0·80
Total for 52 weeks...	1,331,703,000	3,659,000	57	37·49
Total for 52 weeks ending Mar. 26th, 1930	1,227,083,000	3,371,000	52	34·84

A measurable rainfall occurred on 212 days, as compared with 184 days during the previous year.

Sludge Disposal.

In the following table is given the amount of sludge removed during the year from the various tanks :—

	Tons
Screening, etc.	340
Conical Tank	570
Detritus Tanks, Sedimentation Tanks, and Activated-sludge Tanks	17,270
Emscher Tanks	560
Total	18,740

The total amount of sludge produced, viz., 18,740 tons, is equal to 14·7 tons per million gallons.

The sludge from the detritus, sedimentation tanks, and activated-sludge tanks has been trenched into the land as usual.

Emscher Tanks.

A general description, together with plan, of these tanks was given in the Report for the year ending March, 1915.

The tanks have been in continuous operation throughout the year and have dealt with 252,238,000 gallons of sewage, an average of 693,000 gallons per day, as compared with a daily flow of 721,000 gallons during the preceding year.

A total of 560 tons of sludge was discharged from the tanks on to the drainage beds provided. The air-dried sludge has been used on the land under cultivation.

A portion of the gas resulting from the digestion of the sludge is collected and used in the laboratory for heating purposes.

Filtration of Effluent from Sedimentation and Emscher Tanks.

Of the total flow of 1,331,703,000 gallons of sewage received at the works, 581,965,000 gallons were treated by the activated-sludge process, and the remainder, viz., 749,738,000 gallons, was dealt with on the filtration areas.

The storm beds dealt with a total volume of 88,592,000 gallons, which is equal to 97,000 gallons per acre per day. The primary and secondary beds dealt with a total volume of 661,146,000 gallons, which means that on the average (including all periods of rest), tank effluent was applied to the primary beds at the rate of 303,000 gallons per acre per day.

The work on the surface of the filter beds in connection with the removal of accumulated sludge and of heavy growths of weeds, etc., has proceeded as usual, the cost of which for the various filtration areas is given in Table II.

Treatment of Sewage by the Activated-Sludge Process.

Purification plant in operation for the treatment of sewage by the activated-sludge process—diffused aeration system—consists of (i.) a small continuous-flow unit installed in 1917, and described with plan in the Annual Report for the year ending March, 1918, and (ii.) a large-scale continuous-flow unit installed in 1923 and modified in 1926. A description of the large-scale unit as originally installed is given with plan in the Annual Report of 1923 ; the modifications of 1926 are referred to in the Annual Report of 1927.

The air-compressing plant comprises two reciprocating compressors, driven by 27 and 30 H.P. electric motors respectively, each capable of compressing approximately 700 cubic feet of free air per minute, and a special type compressor (installed in 1924), driven by a 25 H.P. electric motor, capable of compressing 400 cubic feet of free air per minute. One of the larger compressors is used as a stand-by.

The normal working pressure is 4lbs. per square inch.

Each purification unit is provided with meters, etc., for recording the volume of sewage treated and the volume of air used. A meter is also provided for the measurement of the electrical units consumed.

Prior to passing to the aeration tanks the sewage is screened and freed from the coarser suspended solids by passage through detritus tanks having a capacity equivalent to 40 mins. D.W.F. ; and, in the case of the larger unit, the sewage since May 22nd, 1930, has received additional sedimentation.

During the past year the small-scale unit has been in continuous operation. The large-scale unit has been in operation for 362 days out of the 364 days of the year, treating detritus free sewage for the first 55 days and tank effluent for the last 307 days. The total volume of 581,965,000 gallons of sewage dealt with by these units during the year represents approximately 44 per cent. of the total volume of sewage received at the works.

Details of operation, with average analytical returns, are as follows :—

Activated-Sludge Process—Withington Works.

	Small unit	Large unit
Days in operation	364	362
Total volume of sewage treated	135,895,000 gallons	446,070,000 gallons
Volume of sewage and/or tank effluent treated per day (average)	373,000 ,,	1,232,000 ,,
Air consumption :—Free air per gallon of sewage treated..	1·04 cub. ft.	0·85 cub. ft.
Average detention period (aeration tank)..	3·9 hours	5·0 hours

Analytical Returns—Results in parts per 100,000.

	Small unit		Large unit	
	Screened and detritus-free sewage	Effluent	Screened and detritus-free sewage or sedimentation tank liquor	Effluent
Four hour oxygen absorption at 26·7° C.	4·64	1·00	4·19	1·06
Three minutes oxygen absorption*				
Before incubation	1·59	·25	1·43	·28
After incubation	—	·22	—	·25
Putrescibility	—	$8\frac{1}{2}$/353	—	$24\frac{1}{2}$/350
Ammoniacal nitrogen	1·82	1·74	1·95	1·84
Albuminoid nitrogen	·51	·13	·49	·14
Nitrous nitrogen	—	trace	—	trace
Nitric nitrogen	—	·085	—	·08
Biochemical oxygen demand (†Royal Commission Test) ..	18·55	1·25	15·63	1·38
Suspended solids	19·0	1·14	15·8	1·22

* At room temperature, approximately 18° C.

† Standard recommended not more than 2·00.

Small Unit.

The high quality effluent usually obtained from this unit has been well maintained throughout the year. No difficulties have arisen with respect to sludge control.

Owing mainly to the incidence of the rainfall during the year, it has been possible to treat a larger volume of sewage than has hitherto been recorded for this plant, with a correspondingly lower air consumption per gallon of sewage treated.

Large Unit.

The treatment of sedimentation tank effluent in this unit, instead of screened and detritus-free sewage, was commenced on May 22nd, 1930.

This change in practice was made with a two-fold object. Firstly, with a view to an improvement in the quality of the general works effluent, particularly during dry weather, by increasing the proportion of the activated-sludge process effluent ; and secondly, in order to obtain further information as to the possibilities of the treatment of a weak domestic sewage by a combined sedimentation tank and activated-sludge process.

As anticipated, the results so far obtained show that the volume of sedimentation tank liquid which can be treated by the activated-sludge process, per unit, is substantially more than the volume of screened and detritus-free sewage ; and the volume of air required for purification, in terms of free air per gallon of sewage treated is appreciably less.

On the other hand, little evidence is forthcoming to indicate, when starting *de novo*, that this method of treatment of a weak domestic sewage is to be preferred to the method wherein the sewage is directly treated by the activated-sludge process.

Power Costs.

The all-in power costs, with respect to the treatment of sewage by these units during the past year, are given below :—

Total volume of sewage and/or tank liquor treated (two units)	581,965,000 gallons
Average pressure air mains	4·2 lbs.
Electrical units consumed—total	235,210
Cost per unit	0·66d.
Cost per million sewage treated	£1 2s. 3d.

Moss Side Sewage Works.

The storm-water overflow at these works came into operation on 82 occasions during the year ; the average depth measured over a 6ft. sill was 9 inches.

The total amount of semi-dried sludge removed from the storm-water lagoons was 145 cubic yards.

The River Mersey overflow channel came into operation three times during the year, whilst further heavy flooding occurred by reason of the increasing break of the Mersey bank at a point adjoining the works owned by an adjacent authority.

The maintenance costs are given in Table III.

Gorton Sewage Works.

As previously reported, these works are no longer in commission for the treatment either of sewage or storm-water, but the Department has been unable to dispose of the property. The charges on these works are given in Table III.

Middleton Sewage Works.

These works are retained to provide tank treatment for a certain proportion of storm-water. The sludge collected in the tanks is passed on to drainage beds, which have been partly redrained during the year. Approximately 200 tons of air-dried sludge have been removed from these beds during the year. The expenditure during the year is itemised in Table III.

The Treatment of Sewage at Davyhulme.

Description of Works.

The original works, which came into operation early in 1894, were designed for the treatment of the sewage by chemical precipitation.

The new works for bacterial treatment of the sewage were completed in 1904 so far as to permit at that date of the whole of the dry-weather flow being dealt with in tanks and primary contact beds.

A general plan showing the arrangement of the existing works appeared in the Annual Report for the year ending March, 1923.

The sewage, as it reaches the works, passes through a system of screens and catch-pits, designed to intercept coarser floating matter and heavy detritus.

Subsequently the sewage passes through either sedimentation or open septic tanks, and, at the present time, that portion of the tank effluent not treated on the existing contact beds passes direct to the Ship Canal.

The sludge removed by tank treatment of the sewage is discharged, either by gravity or pushed by manual labour, into subway channels leading to two ejectors, from which the majority of the sludge is forced under air pressure into three storage tanks near the banks of the Ship Canal below Barton Locks. The sludge is removed from these tanks by (*a*) gravity flow to the sludge steamer, and subsequently is deposited at sea beyond the Mersey Bar, and (*b*) pumping through the sludge main for disposal on land at Flixton and Carrington.

If required, a small proportion of the sludge may be dewatered in plate presses, and the resultant cake disposed of as a manure, either with or without subsequent drying in a rotary drying plant.

A complete description of the scheme originally sanctioned by the Local Government Board is given in the report, entitled "Treatment of Manchester Sewage," issued in July, 1902, where the details of construction of the primary contact beds and storm-water beds may be found.

Subsequently permission was granted by the Board to construct the secondary beds at Bent Lanes, adjacent to the original works, instead of at Carrington and Flixton.

A general description of the construction of the secondary beds is given in the Annual Report for the year ending March, 1909.

Extension of Works.

As foreshadowed in the last annual report, the accepted tender for the activated-sludge units received the approval of the Ministry of Health in October, 1930, and work on this contract was commenced on the 16th November, 1930.

The scheme is designed to treat a D.W.F. of 17,600,000 gallons per day, 16 million by air diffusion, one million and 600,000 by the " Simplex " and bio-aeration systems respectively. The two latter are experimental units and will be described fully as the work proceeds.

The air diffusion scheme consists of six aeration tanks and one reactivation tank 354ft. long and 45ft. wide, each divided into three separate channels 15ft. in width, giving a total of 1,062ft. to each unit. In the floor of these 15ft. channels are three lines of diffusers with a transverse line every 42ft. immediately before a baffle wall under which the sewage must flow. The top water level is 15ft. above the diffusers and these are supplied with compressed air by means of cast-iron pipes carried in troughs on the dividing walls in each unit.

Each of the six aeration tanks has 16 settlement tanks, with eight on each side of the mixed liquor channels, and fed from these by Clifford inlets. The tanks are 20ft. square for a depth of 9ft. 6in. and then in a depth of 17ft. reduced to 6in. diameter in the form of a hopper, the sludge being drawn from here through 5in. earthenware pipes to the return sludge channels, and thence by air lifts to the reactivation tank and mixing channel.

There are four cast-iron bellmouth effluent weirs, 12in. in diameter, in each settlement tank and the effluent flows from these to channels connected to the main effluent channel, 7ft. wide, and the culvert already constructed and described in the last annual report.

Most of the site for the aeration tanks is about 26ft. and that for the settlement tanks 20ft. above formation levels, necessitating about 12 months work for two steam navvies and one dragline. The estimated amount of excavation is 185,000 cubic yards, and arrangements have been made with the Manchester Ship Canal Company to tip the surplus material on their low-lying land on both sides of Longford Brook, east of Crofts Bridge, and just north of Lostock Road to an approved level.

The low-lying ground on the site of the settlement tanks was enclosed in Larssen steel sheet piling 25ft. long on the north-west side and the north-east and south-west sides to the line of the stream ; from here 17ft. 6in. and 10ft. lengths were used according to the level of the clay proved by boreholes. The total piling driven amounted to 21,500 sup. ft. and the weight 315 tons.

Owing to the nature of the ground it was found necessary to drive reinforced concrete bearing piles to carry the outside walls of the settlement tanks and the surplus sludge gauging chamber. These piles were 14in. square with cast-iron shoes reinforced by eight $\frac{7}{8}$in. diameter steel bars with $\frac{1}{4}$in. diameter binders at 6in. centres, these binders being increased to four and finally eight to 1ft. at the head and shoe of the piles. The number of piles driven amounted to seventy-nine 30ft. and thirty-one 25ft. in length, being so spaced as to take a load of six tons per foot run of wall.

Fourteen settlement tanks of Unit No. 1 are in various stages of construction, the concrete being distributed by an Insley Tower, 248ft. in height, and flowing down a chute to its final position, the depositing area being determined by a derrick controlling the work within a radius of 195ft. A second derrick is in course of erection and will shortly be depositing concrete distributed from the same tower.

A new administrative building has been completed and occupied by the staff and a transformer house is in course of construction.

The cost of the completed work is £188,352, including £45,812, the amount paid to date in respect of the new activated-sludge units.

Power Supply.

The steam plant was displaced in September, 1923, and since February 2nd, 1924, the works have been supplied with current by the Corporation Electricity Department by direct cable from the Barton Power Station, at a pressure of 6,600 volts to two 250 K.V.A. transformers, where it is stepped down to 440 volts for power and 220 volts for lighting purposes.

Panel switch-boards, complete with main cut-outs and meters, are provided for both high and low tension current.

The motors throughout the works are designed for 3-phase, 50 cycle A.C. current, and have a total working output of 500 B.H.P.

There are two 60 B.H.P. motors for driving Alley-McLellan air compressors (high pressure) for operating sludge ejectors and sludge presses; two 47 B.H.P. motors driving two 10in. Gwynne "Invincible" pumps, each capable of delivering 2,500 gallons per minute against a 40 foot head, employed for pumping off top water from sedimentation and septic

tanks prior to removal of sludge ; one 35 B.H.P. motor driving the new activated-sludge compressor and three 30 B.H.P. motors for driving three Reavell air compressors (low pressure) intermittently employed in connection with the activated-sludge plant ; one 30 B.H.P. motor driving a Ruggles-Coles dryer, and one 24 B.H.P. motor also used in connection with sludge drying ; one 20 B.H.P. motor used for driving purposes in the fitting shop ; two 20 B.H.P. motors for operating sewage screens and elevators ; two 10 B.H.P. motors for operating the two clinker washing plants ; and small motors from 1·5 to 10 B.H.P. used for sundry other purposes, including the operation of the screens in the new screening chamber.

Drainage of the Parish of Davyhulme.

Some time ago an agreement was entered into with the Barton Rural District Council to treat the sewage from the Davyhulme Parish at the Davyhulme Works.

The sewage contributed by the population in Crofts Bank Road, Barton Road (part of), Davyhulme Road, and Bent Lanes is discharged at two points—*i.e.*, Point " C " and Point " E." That discharged at Point " C " passes over shallow filter beds, and then into the feed channel to the secondary beds.

The sewage delivered at Point " E " is conveyed by means of a 2ft. diameter brick sewer, on which a storm-water overflow is fixed at the Bent Lanes Brook, and which is intended to limit the volume of sewage passed on the estate of the Corporation. The sewage is delivered into a manhole referred to in the Agreement as Point " E," and from which it gravitates through three 6in. diameter cast-iron pipes to a " recorder chamber," where the flow is measured by means of a " V " notch of the type designed by Messrs. Lea, of Manchester, and has a maximum recording capacity of 10,000 gallons per hour. After passing over the notch the sewage flows on to pneumatic ejectors of 200 gallons capacity, in duplicate, each fixed in cast-iron tubbing.

These ejectors raise the sewage by means of compressed air, supplied from the main engine house at the works, into the main sewage channel.

Area of Land.

The total area of land comprising the Davyhulme Works amounts to 254·0 acres, and is divided up as follows :—

	Acres
Land occupied by storm-water, detritus, open septic tanks, and activated-sludge plant	15·0
Land occupied by buildings, sludge tanks, etc., and land occupied in connection therewith	15·0
Land occupied as wharves, lay-byes, and storage	5·0
Land occupied by first contact bacteria beds..	46·0
Land occupied by second contact bacteria beds	39·0
Land occupied by disused storm-water filters...	26·8
The area of land not occupied by bacteria beds, buildings, tanks, etc., but includes existing roads, railway and embankments, and disused river bed	107·2
Grand total	254·0

Tenancies, etc., of Land.

During the year covered by this Report the Committee's lands at Carrington and Flixton have been supervised from the Central Office as heretofore, and periodical inspection of crops has been made by the officer of the Agricultural Committee of the Corporation. There have been several minor changes of tenancy, one of them due to the taking over by the Department of a small area of land in Flixton to provide an outlet for a scour valve on the sludge main.

The whole of the Flixton lands in the River Mersey meadows continue to be utilised by the Department either for crops or for sludge disposal operations. On economic grounds the sowing of root and corn crops has been abandoned, and in future only grass crops will be cultivated, and these only on areas which are not in immediate use for sludging operations.

The total area of land let to farmers, etc., at the date of this Report is approximately as follows, viz. :—

	Area a.	r.	p.		Annual Rental £	s.	d.
Townships of Stretford and Davyhulme	11	0	1	..	18	13	11
Township of Carrington ..	89	3	10½	..	108	15	10
Township of Flixton	65	2	2	..	125	17	10
Totals	166	1	13½	..	£253	7	7

The tenants of the Carrington land having dissolved partnership, notice has been received to terminate the tenancy of their holding on the 2nd February, 1932.

It is not proposed at present to relet this land, which may very likely be required in the near future for sludge disposal purposes under the scheme of extensions now proceeding at Davyhulme.

Temporary Tenancy of Land at Davyhulme.

The Department has entered into an arrangement with the Manchester Ship Canal Company for the tenancy of approximately 23 acres of land adjoining Lostock Road, Urmston, for the deposit of 190,000 cubic yards of spoil from the excavations for the new activated-sludge units at the Davyhulme Sewage Works. Compensation has been paid to the tenant over whose land wayleave has been necessary for the passage of the spoil railway.

River Mersey Banks.

The year has been a bad one for the unstable banks of the River Mersey on the Committee's lands at Carrington and Flixton. There have been several falls, chiefly following heavy floods, necessitating an expenditure during the year of £763 for repairs. Of this amount, £241 was refunded by the Gas Department, partly because the Rivers Department considered some of the falls were due to the operations of the Gas Department, and partly in return for protection afforded to the piers of the lattice work bridge carrying the high-pressure main from the Partington Gas Works over the River Mersey. The repair work was carried out by the employment of labour provided by the Public Assistance Committee in accordance with a scheme of co-operation for the relief of unemployment, and the Public Assistance Committee contributed £91 towards the expenditure.

Volume of Sewage Treated.

The volume of sewage delivered at the works from March 27th, 1930, to March 25th, 1931 (inclusive), including 59,052,000 gallons from the Parish of Davyhulme, was 17,872,074,000 gallons.

The average daily flow of sewage was 49,099,000 gallons, showing an increase on the previous year of 183,000 gallons, or 0·4 per cent.

The average daily flow of sewage per head of population has ranged from a minimum of 45 gallons for the four weeks ending June 18th, 1930, to a maximum of 82 gallons for the four weeks ending August 13th, 1930.

Monthly Recorded Sewage Flow and Rainfall.

Period of four weeks ending	Sewage		Rainfall				
	Flow Gallons	Average Daily Flow Gallons per head	Davy-hulme Inches	Oldham Road Inches	Platt Fields Inches	Heaton Park Inches	Godlee Obser-vatory Inches
1930							
April 23rd	1,131,658,000	52	1·25	1·38	1·18	1·71	1·352
May 21st	1,174,274,000	54	1·73	2·15	1·85	2·28	1·822
June 18th	989,119,000	45	1·11	1·55	2·15	1·38	1·580
July 16th	1,049,507,000	48	1·31	1·39	1·43	2·09	1·441
August 13th	1,795,834,000	82	8·91	7·21	8·13	8·47	7·180
September 10th	1,385,671,000	63	3·24	3·17	3·16	3·81	3·376
October 8th	1,252,598,000	57	4·08	3·85	3·77	4·77	3·657
November 5th	1,578,818,000	72	3·92	3·39	3·66	4·11	3·661
December 3rd	1,529,659,000	70	3·68	3·91	3·15	4·15	3·546
December 31st	1,346,055,000	62	2·61	3·03	2·71	3·12	2·605
1931							
January 28th	1,628,278,000	74	3·79	5·03	4·38	4·67	4·478
February 25th	1,749,879,000	80	3·60	3·98	3·63	4·83	4·127
March 25th	1,260,724,000	58	0·52	0·89	0·83	0·71	0·598
Totals for 52 weeks	17,872,074,000	63	39·75	40·93	40·03	46·10	39·423
Totals for 52 weeks ending March 26th, 1930	17,805,247,000	63	39·96	39·74	35·82	44·14	37·224

The number of days on which a measurable fall of rain (·01 inch or over) occurred during the 52 weeks was as follows :—

Davyhulme	199	days.
Oldham Road	215	,,
Platt Fields	215	,,
Heaton Park	217	,,
Godlee Observatory ..	216	,,

Total Volume of Sewage Filtered.

The total volume of sewage dealt with by the primary contact beds and by the activated-sludge process during the year amounted to 8,143,132,000 gallons, or 46 per cent. of the total flow of sewage.

Of the total quantity thus dealt with, 6,555,547,000 gallons were treated on the secondary filter beds. This volume is equal to 82 per cent. of the primary effluent, or 37 per cent. of the total sewage flow.

Practically the whole of the unfiltered sewage received treatment in sedimentation tanks prior to its discharge to the canal.

Particulars of the quantities and composition of the raw sewage and unfiltered tank effluent are given in Tables IV. and VII., together with comparative figures for the year ending March 27th, 1929.

The rate of the conversion of pail-closets during the past twenty-six years is given in the following table :—

Period	Number of Pail-closets converted
1905–1909	45,567
1910–1914	34,359
1915–1919	1,071
1920–1924	92
1925–1929	29
1930–1931	55

There are now comparatively few houses not served by the water-carriage system.

The amount of suspended matter in the sewage and various effluents, together with the comparative figures for two preceding years, is given in Table XV.

Sludge Disposal.

The total sludge production during the year was 209,527 tons, which is equal to 11·72 tons per million gallons sewage treated. Of this amount 164,778 tons were sent out to sea, 22,724 tons were pumped to Flixton and deposited on land, and 22,025 tons of water or thin sludge were decanted from the sludge storage tanks (prior to loading the steamer), and discharged on to drainage beds.

During the year the sludge steamer "Joseph Thompson" made 169 voyages, an average of 3·25 trips per week. The total mileage covered was 21,970 (statute), an average of 422·5 miles per week. The total coal consumption was 1,871 tons, an average of 11·07 tons per trip.

The sludge dealt with on the land area at Flixton amounted to 22,724 tons, as compared with 18,829 tons so disposed of during the preceding year. The method of broadcasting the sludge on lightly ploughed land has been retained, with final incorporation of the sludge into the soil by subsequent ploughing.

The laying of the main intercepting drains on this land area is now practically finished, but the full benefit of this drainage work cannot be experienced until the subsidiary drains are laid ; this latter work is now in progress.

Particulars of the cost of sludge disposal are given in Table IV.

Detritus Tanks and Screens.

A full description of the new plant was given in the Annual Report for the year ending March, 1929.

During the past year the ropes used on the screens developed a fault known as "birdcaging," which appeared to be due to an untwisting of the main strands. This caused short lengths of the rope to increase considerably in width and consequently to disarrange the wires as they passed round the top and bottom pulleys. Various expedients were tried to overcome the difficulty, but without permanent success, until finally it proved economical to rewind the screens in their entirety with a type of wire rope deemed to be more suitable for this work. This was completed towards the end of the year under review, and it is hoped that the new ropes will prove to have a useful life considerably in excess of the two years of those used originally.

Particulars of the amounts of material removed by both the old and new plants are given in Table IV., together with the cost of operation.

The more adequate removal of heavy sandy matter has facilitated the cleansing of the main sedimentation tanks. The reduction in cost of tank cleaning must, therefore, be offset against the increase in the cost of detritus removal.

Treatment of the Sewage in Sedimentation Tanks.

The six tanks referred to in the report for the year ending March, 1917, have been in operation as sedimentation tanks throughout the 12 months under observation.

The total flow through these tanks (water-holding capacity, 7,125,000 gallons) during the year amounted to 9,728,942,000 gallons, or 26,727,000 gallons per day.

In the following table particulars are given of the amount and character of the sludge removed from the individual tanks :—

Tank No.	Sludge Tons	Per cent. Water
6	23,109	89·4
7	13,383	87·3
8	23,162	87·7
9	20,079	87·7
10	20,886	88·0
11	28,982	87·7

The total quantity of sludge removed from the sedimentation tanks was 129,601 tons, or 13·3 tons per million gallons treated. The amount of sludge removed from these tanks is equal to 62 per cent. of the total tank sludge production.

Storm Beds.

Removal of media from this disused filtration area has been discontinued. The beds which have been emptied on the easterly side are being used as a site for the disposal of detritus and waste material from the washing of filtering media from the primary contact beds.

Treatment of the Sewage in Open Septic Tanks and Bacteria Beds.

There are now 10 tanks in operation as open septic tanks. The length of each tank is 300 feet, and the width and depth of five of the tanks is 100 feet and 6 feet (average) respectively; the other four tanks are shallower, but of greater width, while No. 12 tank (a portion of which is occupied by the activated-sludge unit) is now only 66 feet wide.

The total holding capacity of the 10 tanks is about 12,000,000 gallons.

The total flow of sewage through the septic tanks during the year amounted to 8,143,132,000 gallons, or 22,371,000 gallons per day.

In the following table are given details of the amount and character of the sludge removed from the various tanks:—

Tank No.	Sludge Tons	Per cent. Water
1	3,189	86·1
2	4,954	89·5
3	14,292	90·8
4	4,762	88·3
5	8,662	90·5
12	9,735	91 6
13	8,228	89·3
14	4,082	87·1
15	4,153	90·3
16	5,900	89·7

The total sludge removed from the septic tanks was 67,957 tons, an average of 8·3 tons per million gallons.

Half-acre Primary Beds.

This filtration area has dealt with a total volume of tank effluent of 7,953,345,000 gallons at an average rate (over the whole area) of 475,000 gallons per acre per day, or 88 gallons per cubic yard per day, as compared with last year's figure of 497,700 gallons per acre, or 92 gallons per cubic yard per day.

During the year under observation the washing, rescreening, and replacement of the media of nine beds has been completed and the beds again placed in commission. These beds had been in operation for periods varying from five years ten months to seven years eleven months since their previous renewal and had received from 5,300 to 7,800 fillings of tank effluent meanwhile.

The average analytical returns, showing the results of treatment together with the volumes of tank effluent dealt with, and comparative figures for the previous year, are given in Table VIII.

The operating, maintenance, and renewals cost are summarised in Table IV., together with particulars relating to the volumes of sewage treated on the various sections of the filtration areas.

Secondary Contact Beds.

In order to obtain the advantage of rest periods during the drier part of the year, the method of operation of these beds has been revised. All the beds during the summer months receive twenty-one fillings per week for three weeks and rest completely on the fourth one. During the winter months the rest week is dispensed with and one day per week allowed instead.

Experimental Half-acre Bed No. 10a.

This bed has been in commission for 26 years and reference to Table IX. will show that 63,397,000 gallons of primary effluent have been treated, an average (including all resting periods) of 348,000 gallons per acre per day or 87 gallons per cubic yard per day. The average analytical returns in this Table show that the quality of the effluent has been well maintained.

No. 1 Secondary Bed.

This converted percolating filter continues to be operated as a contact bed. In spite of the increased quantity of primary effluent dealt with, the results obtained, as set out in Table X., show very little variation from those yielded in previous years.

Second Contact Beds (Nos. 2 to 39).

The details of the construction of these beds are given in the Annual Report for the year ending March, 1909. The usual maintenance attention has been given to the surfaces of these beds, the cost of which is given in Table IV. No renewal work has been undertaken during the year under review.

The quantities of primary effluent treated and the results of the analyses of the filtrates from the various sections of the secondary beds are given in Tables XI. to XIV., together with the corresponding figures for the previous year.

Demonstration Activated-Sludge Plant.

Apart from periodic stoppages to allow of the cleansing of the preliminary sedimentation tank, this plant has been in continuous operation throughout the period under review, dealing with sewage freed from the bulk of settleable solids.

For the reason given in the last Report the air supply available during the first quarter of the year was uncertain and inadequate, and consequently the volume of sewage treated during this period was considerably reduced. Normal conditions were resumed on the completion of the repair of the main air compressor, and during the last three quarters of the year an average daily volume of 616,000 gallons of tank-effluent, with an air consumption of 1·44 cubic feet free air per gallon, and an average detention period (aeration and re-aeration chambers) of 6·6 hours.

The results of treatment are shown by the following analytical returns :—

Average Analytical Returns, expressed in parts per 100,000.

	Raw sewage	Settled sewage	Effluent
Four hours oxygen absorption at 26·7° C.	10·49	8·57	2·11
Ammoniacal nitrogen	2·43	2·65	2·16
Albuminoid nitrogen	·625	·52	·14
Nitrous and nitric nitrogen	—	—	·10
Putrescibility	—	—	5½/342
Biochemical oxygen demand	—	—	1·52
Suspended solids	19·5	10·1	2·5

These results compare favourably with those obtained during the past few years, espcecially when it is borne in mind that during the first quarter of the year the air supply was uncertain and that the plant is not operated under favourable economic conditions, inasmuch as the capacity of the re-aeration chamber is too high in proportion (1 : 2·4) to that of the main aeration chamber.

Ship Canal Water.

The results of the incubation test as applied to the Canal water taken above the works outfall, together with a record of rainfall and air temperatures, are given in Diagram 1.

Once again this Diagram clearly demonstrates the influence of the incidence of rainfall on the quality of the Canal water. As the result of low rainfall during April, May, and June, combined with a rising air temperature, the Canal water was putrefactive on incubation from the last week in April to the middle of July. Abnormally wet weather towards the end of July immediately rendered the Canal water non-putrefactive, despite a warm atmospheric temperature, and this condition of the water was maintained throughout the rest of the year reported upon, except for one or two days in December, which followed a fortnight's drought. It may be noted that the effect of rather more than the normal rainfall during the winter, combined with the minimum air temperature, was to keep the Canal water " sweet " during the rainless month of March, 1931.

The results of the complete examination of the Canal water above and below the works outfall are recorded in Table XVI., together with corresponding results for the preceding eight years. The results of the incubation test only are shown in Diagram 2.

Summary of Results (Davyhulme Works).

The following summary of the results of operation of the Davyhulme Works is submitted :—

Total sewage flow—

Main outfall .. 17,813,022,000		
Davyhulme Parish, Point "E," 59,052,000	= 17,872,074,000 gallons.	
Total sludge removed	= 209,527 tons.	
	= 11·72 tons per million gallons.	
Total volume of sewage filtered (primary contact beds)	= 7,953,345,000 gallons.	
	= 44·5% of the total sewage flow.	
Volume of sewage treated by the activated-sludge process	= 189,787,000 gallons.	
	= 1·1% of the total sewage flow.	
Total volume filtered by secondary beds	= 6,555,547,000 gallons.	
	= 82% of the primary effluent.	
	= 37% of the total sewage flow.	

Total Revenue Cost (apart from Interest Charges and Repayment of Debt) :—

= £3 8s. 4·4d. per million gallons.

Average Cost per Head of Population—

	s.	d.
For year ending 25th March, 1931	= 1	6·8
For ten years ending 25th March, 1931	= 1	8·6

Results of Treatment (expressed in parts per 100,000).

Four hours oxygen absorption at 26·7° C.			Albuminoid nitrogen		
Raw sewage	Average effluent, including unfiltered tank effluent	Percentage purification	Raw sewage	Average effluent, including unfiltered tank effluent	Percentage purification
11·04	5·78	48%	·635	·335	47%

In Table XVII. will be found particulars of the cost of sewage treatment at Davyhulme for the period 1896-1931, including the total outlay on sewage disposal works up to date, annual maintenance, and annual capital charge (payment of interest and repayment of debt), which has been estimated on the basis of 5 per cent. of the outlay to date. The costs are also given in terms of the amount per head of population. The percentage purification effected by the treatment of sewage during the different years is also shown, together with the estimated population connected to the sewers.

Research Work.

Research work during the year has been almost entirely confined to a further study of the possibilities of secondary digestion of sludge as an aid to the solution of the future problem of sludge disposal at the Davyhulme Works.

Laboratory experiments have been made in respect of the fermentation (secondary digestion) of some of the main constituents of sewage sludge, viz., (*a*) paper, (*b*) grease, and (*c*) fæcal matter. The results so far obtained are summarised in the Appendix to this Report. It is of interest to note that of these constituents grease or fatty matter gives the highest gas production per unit of dry organic matter, and this affords a ready explanation of the variation reported by observers in respect of the total gas yield from different sewage sludges, inasmuch as their grease (ether extract) content may vary very considerably.

Another study of the fate of nitrogen during the course of the secondary digestion of sewage sludge is also included in this Appendix.

With the view of obtaining information on the economics of the process of sludge digestion at warm temperatures, and of exploring the possibilities of thermophilic digestion, the laboratory experiments described in the last Report have been transferred on to a practical scale by the installation of two specially constructed sludge digestion chambers, each of some 3,000 gallons capacity.

A description of this demonstration plant, accompanied by plans and photograph, is given in Appendix to this Report.

As this plant was only brought into commission late in January of this year, sufficient data has not yet been obtained to allow of any considered judgment on the question at issue. An account of the method of establishing a ripe sludge, together with a general description of the method of operating this plant and a survey of the results obtained, is given in the above-mentioned Appendix.

The above-mentioned digestion plant, which was designed by the Resident Chemist (C. Jepson, M.SC., A.I.C.) along the lines adopted by Buswell of Illinois University, U.S.A., in his experimental work, is under the control of the Research Chemist (W. T. Lockett, M.SC.) assisted by A. Bradwell, A.M.C.T., and R. Hicks, A.R.T.C. Assisted by E. E. Jones, M.SC., the Research Chemist has been responsible for the other experimental work dealing with sludge digestion. The whole of the technical work of the Department is subject to the direction of the Consulting Chemist.

Concluding Remarks.

It will be seen from the foregoing Report that the last section of the Extension Scheme in progress at the Davyhulme Outfall Works has been entered upon during the year under review. viz., the construction of activated-sludge plant for the treatment of rather more than one-half the dry weather flow of sewage, together with the proportionate volume of storm-water. It is anticipated that this new purification plant will be brought into commission during the summer of 1933.

In the meantime the attention of the Rivers Committee is being very closely directed to the problem of the economic disposal of the increased volume of sludge which will ultimately obtain, with the view of reducing as far as possible the serious expenditure which has, of necessity, to be faced in this connection in the near future.

On behalf of the Rivers Committee,

G. HAROLD WHITE,

Chairman.

21st September, 1931.

APPENDIX.

Sludge Digestion.

The work described in the last Annual Report in respect of the secondary digestion of sewage sludge has been continued both in the laboratory and on a practical scale.

Laboratory experiments.

Further laboratory trials have emphasised the possibilities of rapid thermophilic (50°–55° C.) digestion of sludge derived from a purely domestic sewage, as reported by Rudolfs, Heukelekian, and others, but they have also corroborated previous observations of the inhibitory effect of trade waste products present in the sludge recovered from the main City sewage received at the Davyhulme outfall works. It would appear that the thermophilic organisms responsible for the digestion of sludge at a temperature of from 50° to 55° C. are more susceptible in this respect than are those established when working at the lower temperature of from 25° to 30° C.

A brief summary is given below of laboratory work undertaken during the year in respect of

(i.) the separate digestion of common components of sewage sludge, viz. (*a*) paper, (*b*) grease, and (*c*) fæcal matter ; and

(ii.) the loss of nitrogen which occurs during the digestion of ordinary domestic sewage sludge.

(I.) *Comparative experiments relating to the separate digestion of* (a) *paper,* (b) *grease, and* (c) *fæcal matter.*

Preliminary experiments in this connection, carried out at temperatures 50°–55° C., indicated the importance of the presence of a high proportion of seeding material, and of sufficient water to ensure proper admixture of seeding and the substance to be digested.

In the experiment described below, therefore, the amount of digested sludge added was sufficient to make the ratio of dry organic matter in it to that in the fresh material 2 : 1, and its water content was adjusted to 94–95%.

Samples of filter paper, crude sewage grease, and fæcal matter were obtained, and the dry organic matter in each determined. The weight of each required to provide 1·5 gramme of dry organic matter was calculated, and this amount was weighed out into a small conical flask. The dry organic matter in a sample of digested thermophilic sludge was also determined, the weight required to provide three grammes of dry organic matter calculated, and this amount was added to each material. The same amount of digested sludge was also put in a fourth flask, to act as a control or blank in the experiment. The flasks were placed in an electric thermostatic bath (52°–53° C.), each being connected to an arrangement for collecting the gas given off during digestion in measuring cylinders over brine saturated with CO_2.

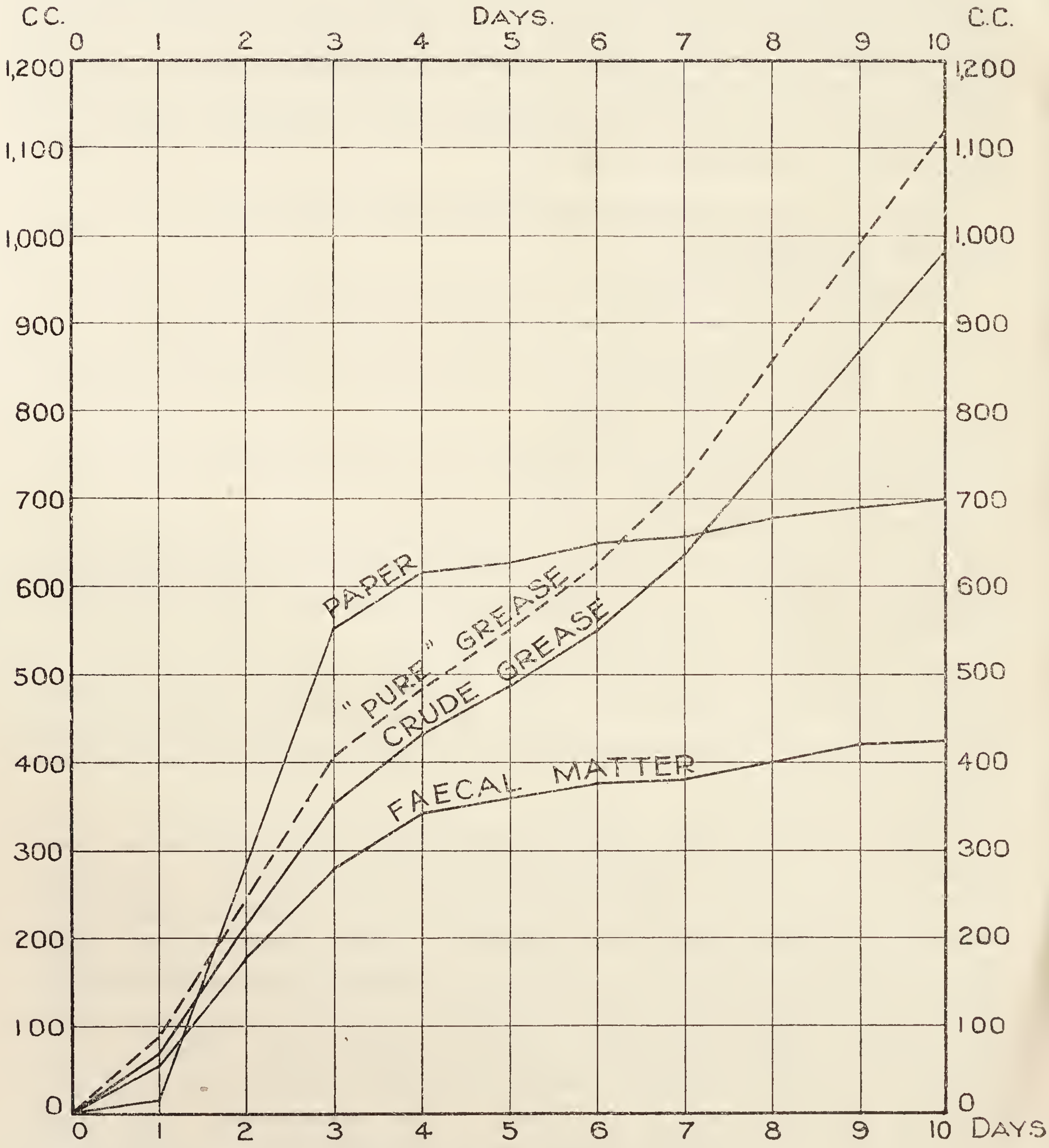
The volume of gas evolved was read every 24 hours, the volume given off from the control subtracted from each of the others, and the results calculated to a basis of one gramme of dry organic matter. The figures thus obtained were plotted, as shown on the curves (Fig. 1).

In the case of the grease the percentage of ether extract (pure grease) was determined, and the figures calculated also to a basis of one gramme of dry ether extract. The figures thus obtained are shown plotted on the dotted line.

FIGURE 1.

Digestion of paper, grease, and fæcal matter at 52°–53° C.

Volume (in c.c.'s) of gas given off per gramme of dry organic matter.



From the above, it will be seen, in the case of

(*a*) *Paper*, that the digestion was exceedingly rapid, and practically complete in three days; a total volume of 700 c.c. of gas per gramme of dry organic matter in the paper was obtained in 10 days.

(*b*) *Grease*, that the digestion is not so rapid, but a larger volume of gas per gramme of dry organic material is finally produced. A total volume of 1120 c.c. per gramme of dry organic matter, calculated on the ether-extractable matter in the fresh material, was obtained in 10 days.

(*c*) *Fæcal matter*, that the digestion was nearly complete in four days, and the total volume of gas given off per gramme of dry organic matter was 420 c.c.

(II.) *Loss of nitrogen during digestion.*

In continuance of the work relating to the fate of nitrogen in raw sludge during digestion, experiments, designed to ascertain precisely the loss of nitrogen occurring during digestion, have been made as follows :—

Two Kjeldahl flasks were taken, and to each was added 50 grammes of a suitable mixture of thermophilic seeding and fresh sludge.

The mixture contained in one flask was acidified with sulphuric acid, and the nitrogen content was subsequently determined.

The flask containing the second 50 grammes of mixture was transferred to a thermostatic bath maintained at a temperature of approximately 53° C.

Digestion of the second mixture was continued over a period of two to three weeks ; and the gas resulting from digestion was allowed to bubble through ammonia-free water or dilute sulphuric acid before passing to the collecting vessel.

On completion of the digestion the nitrogen content was determined of the digested mixture, and also of the water or dilute sulphuric acid through which the gas had bubbled.

The following results were obtained :—

	Experiment A.	Experiment B.
N. contained in mixture before digestion (Flask i.).	·07894 grammes	·1029 grammes
N. contained in mixture after digestion (Flask ii.). .	·07714 grammes or 97·72%	·0993 grammes or 96·50%
Loss	·00180 grammes or 2·28%	·0036 grammes or 3·50%
N. recovered as ammonia . .	·001475 grammes or 1·87%	·0014 grammes or 1·36%
N. unaccounted for	·000325 grammes or ·41%	·0022 grammes or 2·14%

These experiments show that :—

A. Very little, if any, free nitrogen is evolved during digestion at temperatures 50°–55° C.

B. A small proportion of ammonia may pass away with the gas evolved during digestion.

Demonstration Sludge Digestion Plant.

The demonstration sludge digestion plant referred to in the last Report was brought into commission in January, 1931.

The plant is situate in one of the primary contact beds opposite the outlet end of the activated-sludge unit in commission at the Davyhulme Works. It consists of an open concrete receiving tank, 6ft. 3in. × 4ft. 6in. × 5ft. deep, where the mixed sludge receives a preliminary heating before being pumped into either of the digestion tanks, each of which has a capacity of 3,222 gallons. These tanks are 15ft. 6in. deep, square in section, with the lower half in the form of an inverted pyramid. They are constructed of concrete, and the upper half is faced on the outside with brickwork $4\frac{1}{2}$in. in thickness, with an interlining of three layers of "Cellotex," each $\frac{9}{16}$in. thick, for heat insulation purposes.

The two tanks adjoin, but are not otherwise connected in any way, and are designed to be operated at temperatures of 25°–30° C. and 50°–55° C. respectively. The heating system consists of a gas-fired "Bonecourt" tubular boiler, from which hot water circulates through pipes in the form of a grill placed approximately at half depth in the tanks. Automatic apparatus is installed in each tank, by means of which the hot water supply is regulated so as to maintain the desired temperature in the digestion chambers.

Town's gas is laid to the plant, and arrangements exist whereby town's gas or fermentation gas or a mixture of both may be used as the source of heat. The plant is complete with temperature recorders and meters for measuring the volume of gas evolved from each of the tanks.

Drainage Beds.

With the view of obtaining information of a practical value with regard to the drainability of digested sludges, a series of twenty drainage beds, each 16ft. × 6ft., have been laid down on an adjoining area. These beds are 15in. deep, and are constructed with suitably graded cinders with a shallow surface layer of sharp sand. The beds are protected from the effect of a varying rainfall by a cheaply constructed wooden roof, the eaves of which are 6ft. above the bed surface. The total cost of this plant was £1,607—£1,399 for digestion plant (including all equipment and town's gas main, etc.) and £208 for the drainage beds.

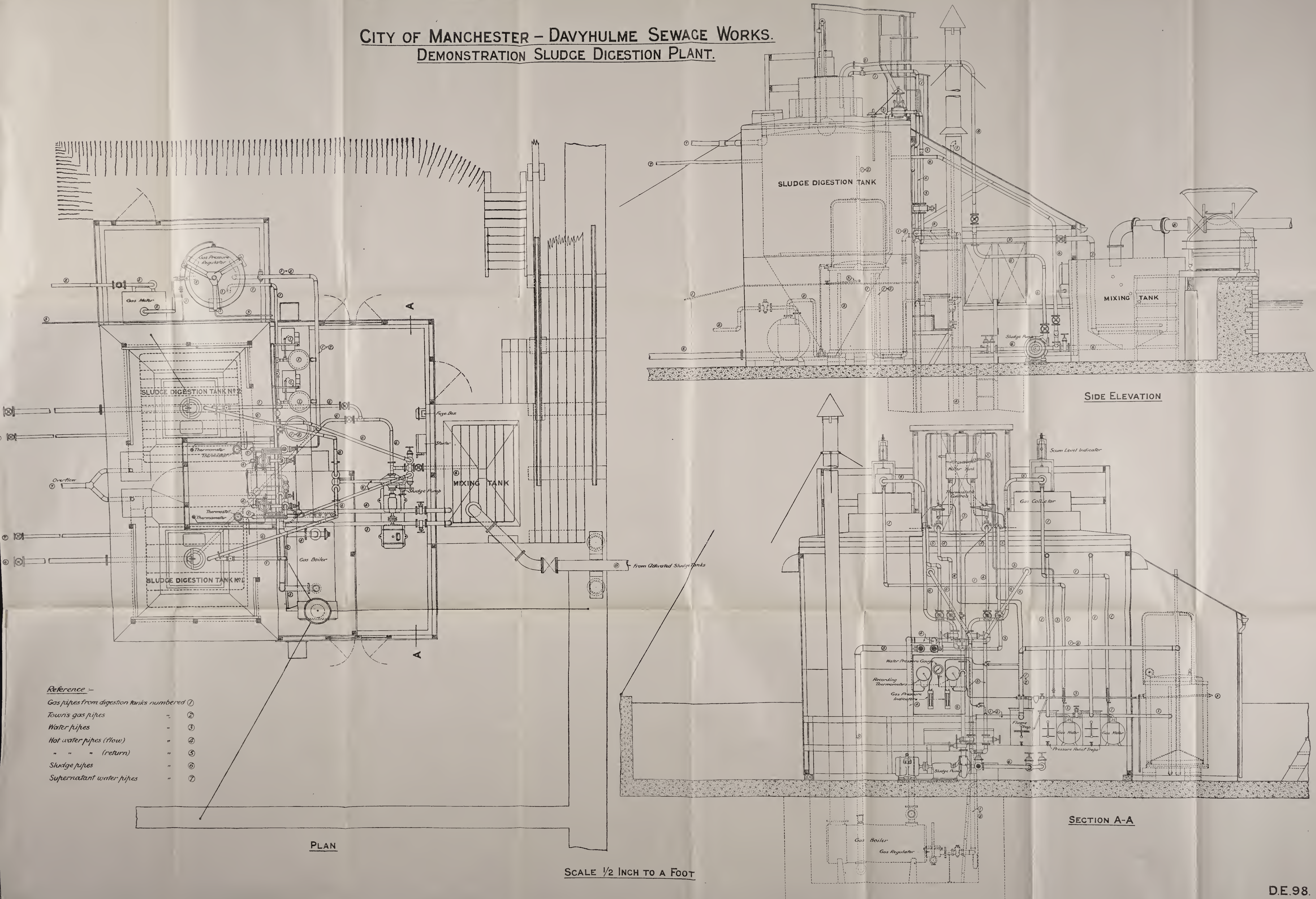
A photograph and detailed drawing of the plant accompany this Appendix.

Heat losses.

Initially, a short investigation was made of the possible heat losses in the digestion chambers during cold weather (January and February), with the result that when filled with activated-sludge effluent the lower temperature digestion tank (at 25°–30° C.) was found to lose 2·0° C., and the higher temperature digestion tank (50°–55° C.) 5·5° C., in the course of standing for 24 hours without additional heat.

DAVYHULME SEWAGE WORKS: EXPERIMENTAL SLUDGE DIGESTION PLANT.

City of Manchester – Davyhulme Sewage Works.
Demonstration Sludge Digestion Plant.



Plan

Side Elevation

Section A-A

Scale ½ Inch to a Foot

D.E.98.

Assuming no increase in temperature due to the digestion process, this means that once the contents of the digestion chambers have been raised to the desired temperature, a maximum (during the winter) of 112,700 B.T.U's per 24 hours will be required to maintain a temperature of 25°–30° C. and of 305,900 B.T.U's to maintain a temperature of 50°–55° C.

Character of sludge.

Up to date the sludge dealt with in this plant has consisted of a mixture of sedimentation (or septic) tank sludge and activated sludge in the proportion of 6 : 1 on the basis of the dry organic matter content of each sludge. In actual practice this means that the sludge employed is generally a mixture of approximately equal volumes of sedimentation (or septic) tank sludge and activated sludge. This proportion has been adopted to agree with the anticipated character of the total sludge to be dealt with at Davyhulme when the new activated-sludge units are in commission. It is proposed later to inquire into the digestion of activated sludge alone.

Digestion of sludge at 25°–30° C. (preliminary account).

A supply of well-digested sludge drawn from the Imhoff tanks in commission at the Withington Sewage Works was used for seeding purposes, and no difficulty was experienced in establishing, within a comparatively short period of time, a well-ripened and thoroughly active sludge.

The batch system of operation was followed during the first 15 weeks, the general procedure being as follows: Volumes of mixed (sedimentation and/or septic tank and activated) sludge, varying from 920 to 1,440 gallons, heated in the preliminary mixing chamber to the desired temperature, were pumped from time to time to the digestion chamber, from which had previously been withdrawn a corresponding volume of digested sludge and/or water, and the whole of the contents of the digestion chamber then mixed by circulation with the pump provided.

The digestion periods, *i.e.*, the intervals between additions of fresh sludge, varied from five to twelve days, with an average of 7·8 days.

The dry solids in the fresh sludge varied from 7·9% to 3·6%, with a mean of 6·1%.

The proportion (by volume) of fresh sludge to seeding (digested) sludge varied from 1 : 2·5 to 1 : 1·2, with a mean of 1 : 1·6. In terms of dry organic matter in the respective sludges, this mean ratio is equivalent to 1 : 1·3.

The pH value of the sludge in the digestion chamber varied from 8·0 to 8·5, and no trouble has been experienced due to acidic conditions.

The volume of gas evolved averaged 284 cubic feet per day, which is equal to 4·7 cubic feet per lb. or 293 cubic centimetres per gramme of the dry organic matter content of the fresh sludge added.

With the view of translating the batch system of working to a more or less continuous operation, the volume of sludge added was considerably reduced during the next ten weeks, and the interval (digestion period) between the fillings curtailed.

During this latter period the average addition of fresh sludge was 639 gallons and the mean digestion period five days. The gas production amounted to 272 cubic feet per day, equal to 5·5 cubic feet per lb. or 344 cubic centimetres per gramme of dry organic matter in the fresh sludge added.

Quite recently the method of operation has been altered, in that each day (except Sundays) digested sludge and/or water has been withdrawn and replaced with fresh (mixed) sludge. Working in this way it has not been considered advisable to circulate the whole contents of the digestion tank after each addition of new sludge, and mixing operations have been more or less confined to the upper portion of the tank by circulating from a pipe fixed 2ft. from the top.

Thermophilic digestion of sludge at 50°–55° C. (preliminary account).

The procedure adopted for the establishment, as soon as possible, of an active thermophilic sludge was based on the methods previously employed in the laboratory, and is briefly described in the following paragraphs.

Initially, the digestion tank (No. 2) was filled with 970 gallons of thin sludge digested at 25°–30° C., 500 gallons of water separated in the latter digestion process, 200 gallons of digested domestic sewage sludge from the Imhoff tanks at the Withington Works, and 1,510 gallons of the previously described mixed (sedimentation tank and activated) sludge from the Davyhulme Works.

The contents of the tank were then thoroughly mixed by circulation, and subsequently the tank contents were gradually raised to the required temperature (52° C.).

The usual initial lag period ensued, and it was not until the 10th day that active fermentation was noted. Gas evolution then proceeded steadily until the 25th day, when the total gas production was equal to 307 cubic centimetres per gramme of the dry organic matter content of the fresh (mixed) sludge added.

At this stage some 1,050 gallons of supernatant water were withdrawn and replaced with a corresponding volume of mixed fresh sludge heated to 52° C., and the contents again mixed by circulation.

During this second trial gas was steadily evolved throughout a period of 27 days, but the daily volume of gas was low. On the 28th day a further addition of fresh mixed sludge was made, which resulted in a considerable improvement in the rate of gasification.

During the early part of the third month of operation digestion proceeded satisfactorily, but later (5th and 6th fillings) the digestion, as indicated by the gas production, was definitely retarded. It was presumed that this interference was due to the influence of inhibitory trade waste products present in the raw sludge dealt with, and consequently it was decided to try the effect of mixing some domestic sewage sludge with the next dose of mixed sludge.

The addition of this domestic sewage sludge gave an impetus to the fermentation process, yielding a considerably increased volume of gas, which in 6¾ days reached the equivalent of 386 cubic centimetres per gramme of dry organic matter of the fresh sludge added, whilst in the subsequent filling (8th) the total volume of gas evolved in six days was equivalent to 684 cubic centimetres per gramme of dry organic matter in the fresh sludge added.

In the two following fillings the proportion of domestic sludge was reduced with only a slight falling off in the activity of the mass, and in the later fillings, when treatment of mixtures of sedimentation tank and activated sludge from the Davyhulme Works was resumed, digestion was well maintained.

During the course of this investigation the *p*H value of the sludge in the digestion chamber has varied from 8·0 to 9·0.

Since the most recent results have indicated that the thermophilic sludge in this plant has not yet reached its maximum activity, it is too early to enter into a general discussion of the possibilities of this process of sludge digestion as applied to the problem of sludge disposal at Davyhulme, but it may be of interest to note that up to date the dry organic matter content of thermophilic digested sludge has been substantially lower than that of the same initial sludge after digestion at 25°–30° C., although the gas yield per gramme dry organic matter of the fresh sludge added has been less somewhat. It would thus seem that the progress of the digestion process cannot be determined solely by the volume of gas evolved.

General remarks.

1. Detailed particulars have been kept throughout of the dry solids in the sludge treated, the sludge during digestion, the separated water and digested sludge withdrawn from the digestion tanks, together with their dry organic matter content. A complete record of the volumes of gas evolved is also available. Publication of these details is reserved pending the completion of the inquiry.

2. This investigation is being controlled to some extent by corresponding laboratory digestion trials, designed to serve as a guide to the progress of the reaction in the digestion chambers. It may be noted that the rate of gas evolution in the laboratory follows very closely that obtained in actual practice. These auxiliary laboratory experiments are useful in determining the economic point for recharging the digestion tanks and in ascertaining the relation of total gas yielded when the fermentation is continued to completion, to that obtained under the method of operating the outside plant.

3. Experience has shown that the digested sludge is readily drainable, and that no difficulty need be anticipated in obtaining a portable product by treatment on suitably constructed drainage beds, and that without aerial nuisance or the production of flies.

4. Whilst the results obtained with this plant have been encouraging, particularly so with regard to digestion at 25°–30° C., sufficient evidence is not yet available to allow of a definite expression of opinion on the economics of the process as applied to the problem of sludge disposal at the Davyhulme Outfall Works, mainly by reason of the difficulty in determining the minimum capacity of covered (and heated) digestion chambers required. This question centres round (*a*) the relative merits of "batch" treatment and of continuous daily additions of sludge, (*b*) ready means of removal of separated water from the digestion tanks, (*c*) means of disposal of this strong liquor, and (*d*) how far it is necessary, from the economic point of view, to proceed with the digestion under these conditions, before final disposal, either with or without a secondary digestion for a further period in open tanks of much less costly construction.

5. Under the conditions prevailing at the Davyhulme Works, further information is required as to the simplest and surest means of establishing and maintaining an active thermophilic sludge, and as to how far digestion at 50°–55° C. is liable to be interfered with by the presence of trade waste products in the raw sludge to be dealt with.

LIST OF *TABLES AND DIAGRAMS.

* All analytical results are expressed in parts per 100.000.

Table I.

GENERAL RIVERS WORK.

Costs—1930–31.

	£	s.	d.	£	s.	d.
SURVEILLANCE OF MANUFACTURERS' TRADE EFFLUENTS				329	13	8
SURVEILLANCE OF RIVERS AND STREAMS				341	7	5
WESTHEAD'S WEIR—						
Routine Operation	57	18	0			
Maintenance	0	12	7			
				58	10	7
BIRLEY'S WEIR—						
Routine Operation	2	3	2			
Maintenance	....					
				2	3	2
WORK IN RIVERS AND STREAMS—						
River Medlock				110	9	1
Other Rivers and Streams				9	12	5
CONTRIBUTION TO RIVERS MERSEY AND IRWELL JOINT COMMITTEE ..				1,950	0	0
INSPECTION OF RIVER BANKS (ENGINEERING DEPARTMENT)				3	10	10
CULVERTING OF RIVERS AND STREAMS BY OWNERS. ENGINEERING DEPARTMENT'S SUPERVISION				19	6	0
RIVER MEDLOCK INVERT MAINTENANCE				66	18	6
SETTLING BASIN ON RIVER MEDLOCK AT CLAYTON				5	0	0
RIVER MERSEY IMPROVEMENT SCHEME				2	15	11
COMMITTEE AND CENTRAL OFFICE ADMINISTRATION AND CONSULTING SERVICES (PROPORTION)				52	8	2
				2,951	15	9
Less :						
Rents and Privileges	*11*	*3*	*9*			
Sale of Sundry Materials, etc.	*1*	*0*	*9*			
				12	*4*	*6*
				£2,939	11	3

NOTE.—In comparing these costs with the charge on the rates (*see* page 6) the sum of £3 7s. 8d. (overlapping accounts) must be deducted.

WITHINGTON SEWAGE WORKS. **Table II.**

Cost of Sewage Treatment, 1930-31.

	£ s. d.	£ s. d.
SCREENS AND CATCHPITS—		
Routine Cleaning and Operation	114 8 4	
High-level Screen Maintenance	....	
Low-level Screen Maintenance	0 17 8	
Conical Catchpit Detritus Removal	45 5 3	
Conical Catchpit Maintenance	0 2 8	
		160 13 11
SETTLEMENT TANKS—		
Routine Cleaning and Operation	128 7 1	
Emscher Tank Maintenance	5 15 8	
Sedimentation Tank Maintenance	4 9 11	
		138 12 8
SLUDGE DISPOSAL ON LAND—		
Digging, Filling, and Covering Grips and Lagoons	286 5 3	
Ejector and Pipe Maintenance	4 1 0	
Emscher Sludge Beds and Drying Ground	64 17 11	
Ejector House Maintenance	0 5 1	
Electric Current and Supervision	38 4 2	
Power House Charges (proportion)	99 15 8	
Air-Compressor Maintenance	2 18 2	
	496 7 3	
Less: Sale of Sludge	*5 18 6*	
		490 8 9
		£789 15s. 4d.
BACTERIA BEDS—		
Routine Operation	302 14 8	
Primary Beds: Medium Surface Maintenance	536 16 5	
Secondary Beds: Medium Surface Maintenance	511 19 1	
Storm Beds: Medium Surface Maintenance	7 11 1	
		1,359 1 3
CARRIERS—		
Routine Cleaning	12 2 4	
Maintenance	5 13 7	
Construction of Carrier	17 17 11	
		35 13 10
ACTIVATED SLUDGE PLANTS—		
No. 1 Plant:		
Routine Operation	81 13 8	
Tank Fabric Maintenance	....	
Tank Equipment Maintenance	22 0 6	
No. 2 Plant:		
Routine Operation	117 16 2	
Tank Fabric Maintenance	5 10 6	
Tank Equipment Maintenance	25 11 9	
Electric Current and Supervision	726 19 7	
Power House Charges (proportion)	195 8 0	
No. 1 (Jones & Attwood) Compressor Maintenance	19 19 3	
No. 2 (Jones & Attwood) Compressor Maintenance	12 17 11	
No. 3 (Tilghman) Compressor Maintenance	1 11 7	
		1,209 8 11
STORM-WATER PUMP AND RESERVOIR—		
Pump Operation	4 10 1	
Pump Maintenance	....	
Pump House Maintenance	1 0 9	
Storm-water Reservoir Cleaning	....	
		5 10 10
LABORATORY—		
Routine Work	384 8 2	
Building Maintenance	6 17 0	
Maintenance of Gas Chamber and Main, Emscher Tank to Laboratory	2 2 8	
Erection of Greenhouse for Research Work (completion)	4 3 6	
		397 11 4
RIVER BANK AND CHORLTON BROOK BANK MAINTENANCE		189 17 11
ROAD MAINTENANCE		37 8 1
FENCING		13 14 3
GREASE RECOVERY	13 7 6	
Less Sale of Grease	*2 9 0*	
		10 18 6

	£ s. d.	£ s. d.	£ s. d.
LAND CULTIVATION—			
Routine Work		280 17 5	
Implement Repairs		9 2 6	
Experimental Cropping of Sludge Land		6 16 1	
		296 16 0	
Less:			
Sale of Produce	*125 7 9*		
Produce consumed in Stables	*47 0 6*		
		172 8 3	
			124 7 9
MONETARY ALLOWANCES—			
Sickness		20 12 3	
Workmen's Compensation		....	
Additional to Superannuation		41 2 0	
			61 14 3
COTTAGES—			
No. 1 Cottage Maintenance		2 14 6	
No. 2 Cottage Maintenance		1 14 7	
Tenancy Services		11 11 2	
			16 0 3
RENTS, RATES, AND TAXES			901 8 11
PUMPING—			
Electric Current and Supervision		554 11 3	
Power House Charges (proportion)		390 10 1	
No. 1 (19in.) Pump Maintenance		....	
No. 2 (10in.) Pump Maintenance		0 6 7	
No. 3 (10in.) Pump Maintenance		1 15 7	
No. 4 (15in.) Pump Maintenance		....	
No. 5 (2in.) Pump Maintenance		0 11 7	
			947 15 1
WORK FOR OUTSIDE PARTIES (RECOVERABLE)			13 3 0
WEED REMOVAL AND DISPOSAL			30 13 8
CLEANING DITCHES AND WATERCOURSES			3 7 1
SUNDRY UNCLASSIFIED ITEMS			1 11 10
MEADOWS			0 8 9
CONCRETING DESTRUCTOR HOUSE FLOOR		97 14 2	
Less:			
Refunded by Public Assistance Department		*23 0 6*	
			74 13 8
WORKS ADMINISTRATION—			
Routine Work		395 2 4	
Administrative Building Maintenance		0 6 2	
Foreman's Residence Maintenance		1 19 9	
			397 8 3
COMMITTEE AND CENTRAL OFFICE ADMINISTRATION AND CONSULTING SERVICES (PROPORTION)			419 18 8
			7,041 11 5
Less:			
Sale of Sundry Materials		*24 9 2*	
Rents of Cottages and Land		*123 16 5*	
			148 5 7
			£6,893 5 10

	£ s. d.
Average cost per million gallons	5 3 6·3
Average cost per million gallons for year ended 26th March, 1930	5 13 4·7
Average cost per head of population connected to sewers	0 2 1·8
Average cost per head of population connected to sewers for year ended 26th March, 1930	0 2 2·1

NOTE.—In comparing these costs with the charge on the rates (*see* page 6) £54 17s. 4d. (overlapping accounts) must be added.

COST OF SEWAGE TREATMENT, 1930–31.

MOSS SIDE SEWAGE WORKS.

	£	s.	d.	£	s.	d.
BUILDING MAINTENANCE—						
Caretaker's Residence	0	3	1			
Tenant's Residence	4	3	2			
Outbuildings	1	7	6			
				5	13	9
SLUDGE LAGOONS				64	11	2
GENERAL CLEANING, FENCING, AND SUNDRIES				10	18	11
CARETAKER'S EMOLUMENTS				7	4	10
RENTS, RATES, AND TAXES				27	3	8
WATER SUPPLY AND MAIN MAINTENANCE				12	18	5
OUSEL BROOK BANK MAINTENANCE..				0	10	11
SUPERVISION				16	15	0
COMMITTEE AND CENTRAL OFFICE ADMINISTRATION AND CONSULTING SERVICES (PROPORTION)				8	19	5
				154	16	1
Less :						
Rent of House, Privileges, and Sundries				*73*	*10*	*0*
				£81	6	1

In comparing these costs with the charge on the rates (*see* page 6) the sum of 15s. 11d. in respect of overlapping accounts must be added.

MIDDLETON SEWAGE WORKS.

	£	s.	d.	£	s.	d.
RENTS, RATES, AND TAXES				45	3	3
SETTLEMENT TANKS—						
Routine Work	14	12	7			
Maintenance	....					
				14	12	7
SLUDGE LAGOONS—						
Routine Work	26	19	5			
Maintenance	0	18	2			
				27	17	7
GENERAL CLEANING AND SUNDRIES				8	11	2
SUPERVISION				33	10	0
COMMITTEE AND CENTRAL OFFICE ADMINISTRATION AND CONSULTING SERVICES (PROPORTION)				7	19	7
				137	14	2
Less :						
Rent of Building				*20*	*0*	*0*
				£117	14	2

In comparing these costs with the charge on the rates (*see* page 6) the sum of 18s. 1d. in respect of overlapping accounts must be added.

GORTON SEWAGE WORKS.

	£	s.	d.
CLEANING, FENCING, AND WEED DISPOSAL	23	7	8
RENTS, RATES, AND TAXES	302	14	9
SUPERVISION	16	18	0
COMMITTEE AND CENTRAL OFFICE ADMINISTRATION AND CONSULTING SERVICES (PROPORTION)	2	9	7
	£345	10	0
Less : Privilege	*1*	*0*	*0*
	£344	10	0

In comparing these costs with the charge on the rates (*see* page 6) the sum of 5s. 7d. in respect of overlapping accounts must be added.

Sludge, Screen Refuse, and Detritus.

Quarter ending	Sludge Produced	Trips run by Steamer	Screen Refuse No. 1 Plant	Screen Refuse No. 2 Plant	Detritus
1930	Tons		Tons	Tons	Tons
June 25th	59,816	54	211	392	6,648
September 24th	44,306	44	358	403	5,304
December 24th	54,788	35	262	245	4,368
1931					
March 25th	50,617	36	269	201	4,932
Total (52 weeks)	209,527	169	1,100	1,241	21,252
Average per week	4,029	3·25	...	...	...
Average per million gallons	11·72	...	...	...	...
Average for 52 weeks ending March 26th, 1930	12·49	3·44	...	...	...
Average for 52 weeks ending March 27th, 1929	15·07	3·42	...	...	...

Memorandum—164,778 tons deposited at sea; 22,724 tons pumped to Flixton and deposited on land; 22,025 tons water decanted from sludge storage tanks.

	£	s.	d.
Cost for each trip run by Steamer (or 1/6·5 per ton of Sludge).	75	2	8·1

Volume of Sewage Treated.

	Gallons.	Gallons.
Septic Tank Effluent dealt with by Primary Beds (46 acres):—		
Quarter ending June 25th, 1930	1,938,790,000	
,, ,, September 24th, 1930	2,148,410,000	
,, ,, December 24th, 1930	2,004,820,000	
,, ,, March 25th, 1931	1,861,325,000	
		7,953,345,000
Unfiltered Tank Effluent:—		
Quarter ending June 25th, 1930	1,601,115,000	
,, ,, September 24th, 1930	2,260,697,000	
,, ,, December 24th, 1930	2,762,490,000	
,, ,, March 25th, 1931	3,104,640,000	
		9,728,942,000
Activated Sludge Tank (No. 12):—		
Quarter ending June 25th, 1930	32,041,000	
,, September 24th, 1930	58,747,000	
,, December 24th, 1930	48,824,000	
,, ,, March 25th, 1931	50,175,000	
		189,787,000
Total Sewage Flow:—		
Quarter ending June 25th, 1930	3,571,946,000	
,, ,, September 24th, 1930	4,467,854,000	
,, ,, December 24th, 1930	4,816,134,000	17,872,074,000
,, ,, March 25th, 1931	5,016,140,000	
Effluent from Primary Beds, dealt with by Secondary Beds:—		
Quarter ending June 25th, 1930	1,580,710,000	
,, ,, September 24th, 1930	1,480,651,000	
,, December 24th, 1930	1,840,131,000	
,, ,, March 25th, 1931	1,654,055,000	
		6.555,547,000

Average per Day.

	52 weeks ending March 25th, 1931	52 weeks ending March 26th, 1930	52 weeks ending March 27th, 1929
	Gallons.	Gallons.	Gallons.
Primary Beds	21,850,000	22,986,000	21,769,000
Unfiltered Tank Effluent	26,727,000	25,421,000	23,314,000
Activated Sludge Tank	521,000	509,000	514,000
Total Sewage Flow	49,099,000	48,916,000	45,597,000
Secondary Beds	18,010,000	18,188,000	15,768,000

Cost of Sewage Treatment, 1930 1931.

	£ s. d.	£ s. d.	£ s. d.
Detritus Tanks:—			
Cleaning and Routine Operation		1,376 7 11	
Fabric Maintenance		6 18 6	
Pump Maintenance		3 2 7	
			1,386 9 0
Screening:—			
No. 1 Plant			
Cleaning and Routine Work		573 12 0	
No. 1 Screen Maintenance		192 18 7	
No. 2 Screen Maintenance		6 2 11	
Chamber Maintenance		35 13 7	
			808 7 1
No. 2 Plant			
Cleaning and Routine Work		1,795 1 7	
No. 2 Screen Maintenance		183 10 8	
No. 3 Screen Maintenance		168 7 3	
No. 4 Screen Maintenance		160 4 1	
No. 5 Screen Maintenance		133 1 11	
Chamber Maintenance		18 10 7	
		2,458 16 1	
Less: Sale of Screenings		19 14 0	
			2,439 2 1
Settlement Tanks:—			
Cleaning and Routine Operation		564 7 11	
Fabric Maintenance		164 7 2	
Pump Maintenance		2 5 7	
			731 0 8
Sludge Ejectors:—			
Routine Operation		632 13 11	
No. 1 Ejector Maintenance		10 14 2	
No. 2 Ejector Maintenance		14 4 5	
Air Main Maintenance		0 11 7	
Nos. 3 and 4 Ejectors Maintenance		186 14 8	
1" Pump and Motor Maintenance		1 16 9	
Sludge Main Maintenance		......	
Ejector Chamber Maintenance		......	
			846 15 6
Sludge Storage Tanks:—			
Routine Cleaning and Operation		127 19 1	
Tank Fabric Maintenance		2 1 2	
			130 0 3 (£20,294 1s. 11d.)
Sludge Beds:—			
Routine Operation			27 0 0
Sludge Disposal on Land:—			
Sludge Ploughing and Gripping		440 12 8	
Engine and Pump Operation		99 3 3	
Engine and Pump Maintenance		19 2 3	
Sludge Main and Distribution Pipe Maintenance		34 4 0	
Land Draining	543 8 0		
Less: Refunded by Public Assistance Department	7 12 6		
		535 15 6	
			1,128 17 8
Sludge Steamer:—			
Routine Running		8,249 10 5	
Canal Tolls, Insurances and Licenses		1,504 9 1	
Owners' Repairs and Renewals		2,860 8 8	
Jetty Maintenance		45 17 8	
Loading Pipe Maintenance		37 6 9	
			12,697 12 7
Sludge Pressing:—			
Plant Maintenance		27 11 2	
Building Maintenance		13 1 7	
			40 12 9
Dried Sewage Manure:—			
Drier and Plant Maintenance		28 9 9	
Building Maintenance		29 14 7	
			58 4 4
Gauging Sewage Flow:—			
Routine Work			27 5 1
Primary Beds:—			
Routine Operation		2,006 2 3	
Medium Surface Maintenance		3,593 15 11	
Fabric Maintenance		110 1 10	
Medium Renewal		*11,687 2 6	
			17,397 2 6
Secondary Beds:—			
Routine Operation		1,308 13 4	
Medium Surface Maintenance		2,179 13 10	
Fabric Maintenance		4 14 1	
Medium Renewal		†39 1 6	
Erection of Cabin		132 14 5	
Installation of Additional Inlet Valves		64 6 7	
			3,729 3 9
Carriers:—			
Routine Cleaning		39 18 5	
Fabric Maintenance		49 17 3	
Construction of Carrier		123 14 9	
			213 10 5
Activated Sludge Plant:—			
Routine Operation		876 15 2	
Tank Fabric Maintenance		2 2 6	
Tank Equipment Maintenance		10 6 0	
Air Compressing Plant Maintenance		133 13 0	
			1,022 16 8
Grease Recovery:—			
Routine Work			(a) 226 5 8
Road Repairs:—			
Davyhulme Works		73 6 3	
Flixton Estate		41 7 11	
Carrington Estate		......	
			114 14 2
Fencing:—			
Davyhulme Works		117 12 11	
Flixton Estate		2 16 4	
			120 9 3
River Mersey Bank Repairs		763 4 8	
Less: Refunded by Gas Department	240 17 0		
Refunded by Public Assistance Department	91 9 3		
		332 6 3	
			430 18 5
Land Cultivation:—			
Routine Work	1,233 14 2		
Implement Maintenance	34 10 9		
		1,268 4 11	
Less: Sale of Produce	44 8 1		
Produce Consumed in Stables	99 0 6		
		143 8 7	
			1,124 16 4
Gardening			304 19 3
Laboratory:—			
Routine Work	2,122 9 1		
Building Maintenance	6 10 11		
		2,129 0 0	
Less: Work for other Departments		25 4 0	
			2,103 16 0
Sludge Digestion Experimental Plant:—			
Construction of Tank		1,415 6 10	
Construction of Drying Beds (incomplete)		208 2 10	
Routine Operation		191 5 5	
		1,814 15 1	
Less: Sale of Materials		16 3 0	
			1.798 12 1
Davyhulme Parish Sewage:—			
Screening and Pumping—Routine Operation		438 17 4	
Screen, Ejector and Chamber Maintenance		11 16 5	
Air Main Maintenance		...	
Contact Beds—Medium Surface Maintenance		22 7 7	
Recorder Maintenance		0 17 11	
Contact Beds—Fabric Maintenance		30 10 4	
Sewage Main Maintenance		...	
			504 9 7
Monetary Allowances:—			
Sickness		147 8 4	
Workmen's Compensation		72 3 10	
Additional to Superannuation		66 11 10	
Professional Services for Injured Workmen		16 6 0	
			302 10 0
Works Extensions:—			
Technical and Advisory Services		150 0 0	
Temporary Draughtsmen and Engineering Office Sundries		852 17 10	
Sundry Work		99 16 10	
			1.102 14 8
Rents, Rates, and Taxes:—			
Davyhulme Works		4,279 2 10	
Flixton Estate and Buildings		77 19 7	
Carrington Estate and Buildings		31 17 4	
Land Let to Tenants		57 1 9	
			4,446 1 6
Weed Removal and Disposal			238 8 9
Cleaning Ditches and Watercourses:—			
Davyhulme Works		36 3 2	
Flixton Estate		20 1 5	
			56 4 7
Work for Outside Parties (Recoverable)			138 16 9
Land Tenancy Services			4 14 7
Demolishing Disused Drying Shed			47 6 3
Conversion of No. 2 Washer to No. 2 Crusher (incomplete)			127 8 8
Filling in Disused Lime Mixing Tanks (incomplete)			33 18 2
Sundry Unclassified Items			87 15 9
Works Administration:—			
Routine Work		2,549 12 1	
Administrative Building Maintenance		7 6 5	
Manager's Residence Maintenance		3 4 4	
			2,560 2 10
Committee and Central Office Administration and Consulting Services (Proportion)			3,589 2 2
			62,148 5 9
Less:—			
Sale of Sewage Grease		(a) 638 0 0	
Sale of Scrap Metal and Sundry Materials		37 8 9	
Rents of Farm Lands and Privileges		253 13 9	
Work for Outside Parties		130 2 2	
			1.059 4 8
			£61,089 1 1

	£	s.	d.
Average cost per million gallons	3	8	4·4
Average cost per million gallons for year ended 26th March, 1930	3	9	11·6
Average cost per head of population connected to sewers	0	1	6·8
Average cost per head of population connected to sewers for year ended 26th March, 1930	0	1	7·2

In comparing these costs with the charge on the rates (see page 6), a Contribution of £14,489 4s. 0d. from the Local Authorities of Stretford, Middleton, Royton, Audenshaw, and Barton, sums of £101 19s. 3d. (expended out of Bacteria Beds Renewal Account) £229 7s. 5d. (interest on Bacteria Beds Renewal Fund), £460 4s. 0d. (recovered from Sludge Steamer Underwriters), £604 16s. 6d. (net postings from Depreciation Account), and £156 10s. 2d. (overlapping accounts) must be deducted; and £111 8s. 6d. (recoverable from Sludge Steamer Underwriters) must be added.

Washing.

*

Quantity.	Tons.	Cost.	£ s. d.
Fouled Medium Washed	17,693	No. 1 Washer	4,345 0 0
Fouled Medium Rewashed	5,186	Refuse from Washer	678 7 8
Storm Bed Medium Washed or Riddled	10,157		£5,023 7 8
	33,636		

Cost per ton = 2s. 11·8d.

Summary.

	£ s. d.
Emptying Beds	1,801 11 11
Filling Beds	1,118 8 0
Washing Medium	5,023 7 8
Hauling to and from Beds	2,007 3 7
Hauling to Crusher, Crushing, and returning to Washer	1,585 4 2
Purchase of New Medium	187 8 8
	£11,726 4 0

Table V.

SUMMARY OF COST STATISTICS, 1930–31.

DAVYHULME SEWAGE WORKS.

Sludge Disposal at Sea—			
Cost per trip	£75	2	8·1
Cost per ton of sludge	0	1	6 5
Sludge Disposal (including Screen Refuse and Detritus)—			
Average cost per ton	0	1	9
Rail Transport—			
Cost per locomotive and wagons per operative hour (excluding driver)	0	4	8·1
Horse Transport—			
"All-in" cost per horse per working hour	0	1	0·9
Cost of keep per horse per week	0	14	10·1
Motor Transport (30-cwt. "Morris")—			
Cost per operative hour (excluding driver)	0	1	8·8
Miles run	8,153		
Average mileage per week	156·8		
Petrol consumption .. gallons	722½		
Miles run per gallon of petrol	11·3		
Net cost per mile run	£0	0	5·5
Steam Shovel—Cost per operative hour (excluding operator)	0	7	1·2
Clinker Washer—Cost per operative hour (excluding operators)	0	2	5·3
Crusher—Cost per operative hour (excluding operator)	0	1	8·3
Grab Crane—Cost per operative hour (excluding operator)	0	3	0
Workshop Expenses (Cost per hour)—			
Locomotive Fitting Shop	0	0	5·5
General Fitting Shop	0	0	5·6
Blacksmith's Shop	0	0	9·0
Joiner's Shop	0	0	1·0
Painter's Shop	0	0	2·6

Table VI.

DAVYHULME SEWAGE WORKS.

TABLE VI.—COMPARATIVE ANNUAL COSTS, ETC., PERIOD 1925–26 to 1929–30.

Year	Total			Sludge produced	Trips run by steamer	Refuse from screens and detritus tanks	Sewage flow	Cost per million gallons			Average population connected to sewers	Cost per head		
	£	s.	d.	Tons		Tons	Gallons	£	s.	d.		£	s.	d.
1925–26	57,268	17	7	236,101	199	4,925	18,172,380,000	3	3	0·4	754,000	0	1	6·2
1926–27	57,442	13	6	221,546	181	5,085	17,512,465,000	3	5	7·2	757,000	0	1	6·2
1927–28	58,984	7	3	197,792	170	5,042	18,629,970,000	3	3	3·9	760,200	0	1	6·6
1928–29	59,678	15	6	250,114	178	14,075	16,597,536,000	3	11	10 9	763,500	0	1	6·8
1929–30	62,293	17	8	222,407	179	36,996	17,805,247,000	3	9	11·6	778,462	0	1	7·2
1930–31	61,089	1	1	209,527	169	23,593	17,872,074,000	3	8	4·4	781,000	0	1	6·8

TABLE VII.—SHOWING THE CHEMICAL COMPOSITION OF THE RAW SEWAGE (AVERAGE OF HOURLY SAMPLES) AND OF THE UNFILTERED TANK EFFLUENT, TOGETHER WITH THE RELATIVE VOLUMES OF EACH.

DATE	4 Hours oxygen absorption at 26·7 C			Ammoniacal nitrogen			Albuminoid nitrogen			Nitrous nitrogen	Nitric nitrogen	Chloride (in terms of Cl.)			INCUBATION TEST: 3 Minutes oxygen absorption: Before incubation			INCUBATION TEST: 3 Minutes oxygen absorption: After incubation	INCUBATION TEST: Putrescibility	TOTAL QUANTITY Gallons			Percentage of total flow dealt with on the filtration areas and by the activated sludge process
Quarter ending	Manchester raw sewage	Davyhulme Parish sewage	Tank effluent	Manchester raw sewage	Davyhulme Parish sewage	Tank effluent	Manchester raw sewage	Davyhulme Parish sewage	Tank effluent	Tank effluent	Tank effluent	Manchester raw sewage	Davyhulme Parish sewage	Tank effluent	Manchester raw sewage	Davyhulme Parish sewage	Tank effluent	Tank effluent	Tank effluent	Total raw sewage	Davyhulme Parish sewage	Tank effluent (Unfiltered)	
1930																							
June 25th	13·32	7·79	10·38	2·75	2·90	2·83	·72	·71	·585	Trace	·11	19·1	6·9	18·9	4·84	2·55	3·87	6·25	60/60	3,571,946,000	11,193,000	1,601,115,000	55·2
September 24th	9·89	5·45	8·11	2·26	2·63	2·43	·605	·525	·525	Trace	·11	16·6	5·9	14·7	3·87	1·92	3·17	6·01	58½/60	4,467,854,000	14,467,000	2,260,697,000	49·4
December 24th	10·75	4·76	8·73	2·12	2·26	2·11	·57	·425	·475	·01	·16	17·8	5·3	16·3	3·73	1·37	3·24	5·07	60/62	4,816,134,000	17,147,000	2,762,490,000	42·6
1931																							
March 25th	10·21	4·50	8·86	2·09	2·38	1·93	·64	·46	·51	·01	·21	17·6	5·2	15·9	3·58	1·28	3·11	4·30	50½/62	5,016,140,000	16,245,000	3,104,640,000	38·1
Average	11·04	5·63	9·02	2·31	2·54	2·33	·635	·53	·525	·01	·15	17·8	5·8	16·5	4·01	1·78	3·35	5·41	229/244	17,872,074,000	59,052,000	9,728,942,000	45·6
Average for year ending March 26th, 1930	10·26	6·49	8·47	2·47	3·33	2·58	·67	·625	·555	·01	·12	20·0	8·0	19·0	4·46	2·63	3·80	5·01	222/249	17,805,247,000	33,322,000	9,253,210,000	48·0

Results expressed in parts per 100,000.

DAVYHULME WORKS.

PRIMARY BEDS.—Series I., II., III., and IIIa.

Table VIII.

TABLE VIII.—SHOWING QUANTITY DEALT WITH, AND CHEMICAL COMPOSITION OF FILTRATE.

DATE — Quarter ending	4 Hours oxygen absorption at 26·7° C — Raw sewage	Tank effluent	Series I.	Series II.	Tank effluent	Series III. and IIIa.	Ammoniacal nitrogen — Raw sewage	Tank effluent	Series I.	Series II.	Tank effluent	Series III. and IIIa.
1930 June 25th	13·32	11·28	5·57	4·91	8·19	4·19	2·75	2·80	1·82	1·74	3·26	2·26
September 24th	9·89	8·92	4·08	3·34	8·41	3·15	2·26	2·31	1·51	1·41	2·69	2·13
December 24th	10·75	9·82	4·52	3·61	6·96	2·74	2·12	2·31	1·55	1·37	2·34	1·69
1931 March 25th	10·21	9·18	3·79	3·47	7·14	2·77	2·09	1·92	1·35	1·35	2·04	1·80
Average	11·04	9·80	4·49	3·83	7·68	3·21	2·31	2·34	1·56	1·47	2·58	1·97
Average for year ending March 26th, 1930	10·26	9·66	4·59	4·09	7·90	2·96	2·47	2·58	1·88	1·78	2·82	2·16
Purification effected — Calculated on tank effluent			54%	61%		58%						
Purification effected — Corresponding purification for year ending March 26th, 1930			52%	58%		63%						
Purification effected — Calculated on raw sewage			59%	65%		71%						
Purification effected — Corresponding purification for year ending March 26th, 1930			55%	60%		71%						

Quarter ending	Albuminoid nitrogen — Raw sewage	Tank effluent	Series I.	Series II.	Tank effluent	Series III. and IIIa.	Nitrous nitrogen — Series I.	II.	III. and IIIa.	Nitric nitrogen — Series I.	II.	III. and IIIa.
1930 June 25th	·72	·50	·255	·225	·52	·27	Trace	Trace	·01	·11	·10	·11
September 24th	·605	·455	·21	·18	·49	·205	·01	·01	·015	·14	·24	·16
December 24th	·57	·455	·235	·18	·395	·165	·02	·01	·015	·17	·27	·23
1931 March 25th	·64	·47	·195	·185	·46	·195	·015	·01	·015	·36	·37	·28
Average	·635	·47	·225	·19	·465	·21	·01	·01	·015	·20	·25	·20
Average for year ending March 26th, 1930	·67	·51	·26	·23	495	·22	·01	Trace	·02	·09	·09	·16
Purification effected — Calculated on tank effluent			52%	60%		55%						
Purification effected — Corresponding purification for year ending March 26th, 1930			49%	55%		56%						
Purification effected — Calculated on raw sewage			65%	70%		67%						
Purification effected — Corresponding purification for year ending March 26th, 1930			61%	66%		67%						

Quarter ending	Chloride (in terms of Cl) — Raw sewage	Tank effluent	Series I.	Series II.	Tank effluent	Series III. and IIIa.	Incubation test: 3 Minutes oxygen absorption, Before incubation — Raw sewage	Tank effluent	Series I.	Series II.	Tank effluent	Series III. and IIIa.
1930 June 25th	19·1	21·9	19·2	19·4	16.4	14·8	4·84	4·58	2·47	2·14	3·30	1·79
September 24th	16·6	17·1	15·5	15·4	14·5	13·8	3·87	3·78	1·84	1·52	3·54	1·33
December 24th	17·8	20·1	18·2	17·4	13·4	11·8	3·73	4·12	1·93	1·54	2·98	1·10
1931 March 25th	17·6	18·1	16·2	15·7	15·0	14·5	3·58	3·60	1·57	1·47	2·71	1·10
Average	17·8	19·3	17·3	17·0	14·8	13·7	4·01	4·02	1·95	1·67	3·13	1·33
Average for year ending March 26th, 1930	20·0	20·9	19·6	19·4	16·4	15·0	4·46	4·47	2·30	2·06	3·53	1·41

Quarter ending	Incubation test: After incubation — Series I.	II.	III. and IIIa.	Putrescibility — Series I.	II.	III. and IIIa.	Quantity dealt with (Gallons) — Series I.	II.	III. and IIIa.	Average quantity dealt with: Per acre per day (Gallons) — Series I.	II.	III. and IIIa.	Per cubic yard per day (Gallons) — Series I.	II.	III. and IIIa.
1930 June 25th	3·33	2·79	2·48	11/12	9/13	11½/13	873,675,000	294,800,000	770,315,000	480,000	540,000	423,000	89	100	78
September 24th	2·55	1·82	1·67	10/13	8/13	7/13	1,164,560,000	218,620,000	765,230,000	640,000	400,000	420,000	119	74	78
December 24th	2·31	1·71	1·33	6/13	3/12	4½/13	891,330,000	276,040,000	837,450,000	490,000	506,000	460,000	91	94	85
1931 March 25th	1·68	1·47	1·35	3/12	1/11	3½/13	768,815,000	219,290,000	873,220,000	422,000	402,000	480,000	78	74	89
Average	2·47	1·95	1·71	30/50	21/49	26½/52	3,698,380,000	1,008,750,000	3,246,215,000	508,000	462,000	446,000	94	86	83
Average for year ending March 26th, 1930	2·87	2·46	1·69	39/51	35/51	24/52	3,472,295,000	1,388,120,000	3,506,098,000	477,000	636,000	482,000	88	118	89

Results expressed in parts per 100,000.

HALF ACRE SECOND CONTACT BED—No. 10A.

TABLE IX.—SHOWING QUANTITY DEALT WITH AND CHEMICAL COMPOSITION OF FILTRATE.

Date	4 Hours oxygen absorption at 26·7° C		Ammoniacal nitrogen		Albuminoid nitrogen		Nitrous nitrogen		Nitric nitrogen		Chloride (in terms of Cl.)		Incubation test						Total quantity dealt with	Average quantity dealt with	
													3 Minutes oxygen absorption				Putrescibility				
													Before incubation		After incubation					Per day	Per cubic yard per day
Quarter ending	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Gallons	Gallons	Gallons
1930																					
June 25th..............	6·94	2·57	2·09	1·08	·34	·135	Nil	·015	·07	·93	16.6	16·4	3·11	·96	4·79	1·03	12/13	1/10	15,656,000	172,000	86
September 24th........	5·49	2·36	1·88	1·01	·295	·145	Trace	·03	·09	·60	16·3	14·8	2·62	1·04	3·47	·79	11½/12	0/9	14,440,000	159,000	80
December 24th........	5·68	2·05	2·03	·99	·285	·13	·015	·015	·12	·75	17·7	15·5	2·47	·82	3·49	·66	11½/13	0/13	17,176,000	189,000	95
1931																					
March 25th	5·00	1·89	1·81	1·00	·33	·125	·015	·01	·18	1·04	17·1	16·2	2·02	·69	2·80	·60	9½/13	0/12	16,125,000	177,000	89
Average	5·78	2·22	1·95	1·02	·31	·135	·01	·02	·12	·83	16·9	15·7	2·56	·88	3·64	·77	44½/51	1/44	63,397,000	174,000	87
Average for year ending March 26th, 1930..................	5·97	2·06	2·22	1·04	·32	.14	Trace	·03	·11	·91	18·1	16·9	2·89	·91	3·91	·80	39/50	0/44	65,124,000	179,000	90

Purification effected		4 Hours oxygen absorption	Albuminoid nitrogen
	Calculated on primary effluent	62%	56%
	Corresponding purification for year ending March 26th, 1930	65%	56%
	Calculated on raw sewage	80%	79%
	Corresponding purification for year ending March 26th, 1930	80%	79%

Results expressed in parts per 100,000.

No. 1—SECONDARY BED.

TABLE X.—SHOWING QUANTITY DEALT WITH AND CHEMICAL COMPOSITION OF FILTRATE.

Date	4 Hours oxygen absorption at 26·7°C.		Ammoniacal nitrogen		Albuminoid nitrogen		Nitrous nitrogen		Nitric nitrogen		Chloride (in terms of Cl.)		Incubation test: 3 Minutes oxygen absorption, Before incubation		Incubation test: 3 Minutes oxygen absorption, After incubation		Incubation test: Putrescibility		Total quantity dealt with	Average quantity dealt with: Per day	Average quantity dealt with: Per cubic yard per day
Quarter ending	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Gallons	Gallons	Gallons
June 25th, 1930	6·55	3·76	2·14	1·57	·325	·195	Nil	·015	·09	·48	16·7	16·9	2·97	1·69	4·78	1·86	23/23	3/15	68,760,000	756,000	118
September 24th, 1930	5·02	2·70	1·94	1·28	·30	·165	Trace	·03	·10	·59	14.1	15·5	2·29	1·20	3·71	1·05	21½/24	1/8	68,400,000	752,000	118
December 24th, 1930	5·03	2·31	1·72	1·15	·27	·14	·015	·02	·15	·57	14·4	15·9	2·04	·90	3·09	·86	20½/25	½/24	78,480,000	862,000	135
March 25th, 1931 ...	4·82	2·52	1·96	1·40	·29	·165	·015	·015	·19	·65	15·2	16·3	1·97	1·02	2·81	·95	19½/25	1½/25	66,600,000	732,000	114
Average	5·36	2·82	1·94	1·35	·295	·165	·01	·02	·13	·57	15·1	16·2	2·32	1·20	3·60	1·18	84½/97	6/82	282,240,000	775,000	121
Average for year ending March 26th, 1930	5·51	2·77	2·26	1·53	·33	.175	Trace	·03	·09	·39	17·1	19·3	2·69	1·36	3·70	1·33	79/98	6½/80	258,840,000	711,000	111

Results expressed in parts per 100,000.

Purification effected.		4 Hours oxygen absorption	Albuminoid nitrogen
	Calculated on primary effluent	47%	44%
	Corresponding purification for year ending March 26th, 1930	50%	47%
	Calculated on raw sewage	74%	74%
	Corresponding purification for year ending March 26th, 1930	73%	74%

DAVYHULME WORKS.

Table XI.

SECOND CONTACT BEDS—Nos. 5 to 19 (inclusive).

TABLE XI.—SHOWING QUANTITIES DEALT WITH AND CHEMICAL COMPOSITION OF FILTRATE.

DATE	4 Hours oxygen absorption at 26·7° C.		Ammoniacal nitrogen		Albuminoid nitrogen		Nitrous nitrogen		Nitric nitrogen		Chloride (in terms of Cl.)		Incubation test: 3 Minutes oxygen absorption, Before incubation		Incubation test: 3 Minutes oxygen absorption, After incubation		Incubation test: Putrescibility		Quantity dealt with	Average quantity dealt with: Per day	Average quantity dealt with: Per cubic yard per day
Quarter ending	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Gallons	Gallons	Gallons
June 25th, 1930 ...	6·55	2·81	2·14	1·36	·325	·15	Nil	·015	·09	·65	16·7	17·7	2·97	1·14	4·78	1·17	23/23	2½/23	534,447,000	5,873,000	97
September 24th, 1930	5·02	2·18	1·94	1·13	·30	·14	Trace	·025	·10	·57	14·1	14·9	2·29	·91	3·71	·93	21½/24	3/24	531,310,000	5,839,000	97
December 24th, 1930	5·03	1·95	1·72	1·08	·27	·115	·015	·015	·15	·63	14·4	15·5	2·04	·71	3·09	·67	20½/25	0/25	647,145,000	7,111,000	118
March 25th, 1931 ...	4·82	2·09	1·96	1·26	·29	·14	·015	·01	·19	·73	15·2	15·7	1·97	·79	2·81	·75	19½/25	0/25	530,360,000	5,828,000	96
Average	5·36	2·26	1·94	1·21	·295	·135	·01	·015	·13	·65	15·1	16·0	2·32	·89	3·60	·88	84½/97	5½/97	2,243,262,000	6,163,000	102
Average for year ending Mar. 26th, 1930	5·51	2·36	2·26	1·36	·33	·16	Trace	·025	·09	·51	17·1	18·3	2·69	1·11	3·70	1·09	79/98	7½/98	2,318,909,000	6,371,000	105

Purification effected		4 Hours oxygen absorption	Albuminoid nitrogen
	Calculated on primary effluent	58%	54%
	Corresponding purification for year ending March 26th, 1930	57%	52%
	Calculated on raw sewage	80%	79%
	Corresponding purification for year ending March 26th, 1930	77%	76%

Results expressed in parts per 100,000.

DAVYHULME WORKS.

SECOND CONTACT BEDS—Nos. 2 and 20 to 27 (inclusive).

TABLE XII.—SHOWING QUANTITIES DEALT WITH AND CHEMICAL COMPOSITION OF FILTRATE

DATE	4 Hours oxygen absorption at 26·7° C.		Ammoniacal nitrogen		Albuminoid nitrogen		Nitrous nitrogen		Nitric nitrogen		Chloride (in terms of Cl.)		Incubation test: 3 Minutes oxygen absorption: Before incubation		Incubation test: 3 Minutes oxygen absorption: After incubation		Incubation test: Putrescibility		Quantity dealt with	Average quantity dealt with: Per day	Average quantity dealt with: Per cubic yard per day
Quarter ending	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Gallons	Gallons	Gallons
June 25th, 1930	6·55	3·37	2·14	1·47	·325	·18	Nil	·02	·09	·50	16·7	18·0	2·97	1·46	4·78	1·45	23/23	4½/23	273,866,000	3,010,000	91
September 24th, 1930	5·02	2·31	1·94	1·17	·30	·15	Trace	·03	·10	·71	14·1	15·0	2·29	·97	3·71	·89	21½/24	2/24	267,210,000	2,936,000	89
December 24th, 1930	5·03	2·07	1·72	1·08	·27	·14	·015	·02	·15	·68	14·4	15·6	2·04	·81	3·09	·77	20½/25	½/24	285,245,000	3,135,000	95
March 25th, 1931 ...	4·82	2·39	1·96	1·34	·29	·16	·015	·015	·19	·63	15·2	16·0	1·97	·96	2·81	·96	19½/25	1½/25	299,040,000	3,286,000	100
Average	5·36	2·54	1·94	1·27	·295	·155	·01	·02	·13	·63	15·1	16·2	2·32	1·05	3·60	1·02	84½/97	8½/96	1,125,361,000	3,092,000	94
Average for year ending March 26th, 1930	5·51	2·47	2·26	1·33	·33	·17	Trace	·025	·09	·44	17·1	19·1	2·69	1·19	3·70	1·17	79/98	8½/96	1,173,553,000	3,224,000	98

Purification effected		4 Hours oxygen absorption	Albuminoid nitrogen
Purification effected	Calculated on primary effluent	53%	47%
	Corresponding purification for year ending March 26th, 1930	55%	48%
	Calculated on raw sewage	77%	76%
	Corresponding purification for year ending March 26th, 1930	76%	75%

Results expressed in parts per 100,000.

DAVYHULME WORKS.

SECOND CONTACT BEDS—Nos. 32 to 35.

Table XIII.

TABLE XIII.—SHOWING QUANTITY DEALT WITH AND CHEMICAL COMPOSITION OF FILTRATE

DATE	4 Hours oxygen absorption at 26·7° C.		Ammoniacal nitrogen		Albuminoid nitrogen		Nitrous nitrogen		Nitric nitrogen		Chloride (in terms of Cl.)		Incubation test: 3 Minutes oxygen absorption, Before incubation		Incubation test: 3 Minutes oxygen absorption, After incubation		Incubation test: Putrescibility		Quantity dealt with	Average quantity dealt with: Per day	Average quantity dealt with: Per cubic yard per day
Quarter ending	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Gallons	Gallons	Gallons
June 25th, 1930	6·94	2·83	2·09	·91	·34	·145	Nil	·02	·07	·93	16·6	15·4	3·11	1·12	4·79	1·02	12/13	0/9	204,000,000	2,242,000	91
September 24th, 1930	5·49	2·05	1·88	·84	·295	·125	Trace	·015	·09	·73	16·3	12·6	2·62	·79	3·47	·60	11½/12	0/6	143,820,000	1,580,000	64
December 24th, 1930	5·68	2·33	2·03	·97	·285	·14	·015	·01	·12	·77	17·7	15·3	2·47	·99	3·49	·80	11½/13	0/13	226,440,000	2,488,000	101
March 25th, 1931 ...	5·00	2·13	1·81	1·00	·33	·14	·015	·01	·18	·94	17·1	15·5	2·02	·82	2·80	·68	9½/13	0/13	207,000,000	2,275,000	92
Average	5·78	2·34	1·95	·93	·31	·135	·01	·015	·12	·84	16·9	14·7	2·56	·93	3·64	·78	44½/51	0/41	781,260,000	2,146,000	87
Average for year ending March 26th, 1930 ...	5·97	2·33	2·22	·93	·32	·155	Trace	·03	·11	·86	18·1	17·1	2·89	1·07	3·91	·86	39/50	0/34	704,820,000	1,936,000	79
Purification effected: Calculated on primary effluent		60%				56%															
Purification effected: Corresponding purification for year ending March 26th, 1930.		61%				52%															
Purification effected: Calculated on raw sewage		79%				79%															
Purification effected: Corresponding purification for year ending March 26th, 1930.		77%				77%															

Results expressed in parts per 100,000.

DAVYHULME WORKS.

Table XIV.

SECOND CONTACT BEDS—Nos. 36–39 (INCLUSIVE).

TABLE XIV.—SHOWING QUANTITY DEALT WITH AND CHEMICAL COMPOSITION OF FILTRATE.

DATE	4 Hours oxygen absorption at 26·7° C.		Ammoniacal nitrogen		Albuminoid nitrogen		Nitrous nitrogen		Nitric nitrogen		Chloride (in terms of Cl.)		Incubation test						Quantity dealt with	Average quantity dealt with	
													3 Minutes oxygen absorption				Putrescibility				
													Before incubation		After incubation					Per day	Per cubic yard per day
Quarter ending	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Primary effluent	Secondary effluent	Gallons	Gallons	Gallons
June 25th, 1930......	6·94	2·99	2·09	·82	·34	·14	Nil	·015	·07	1·03	16·6	17·0	3·11	1·25	4·79	1·20	12/13	0/9	195,840,000	2,152,000	95
September 24th, 1930	5·49	2·10	1·88	·59	·295	·115	Trace	·02	·09	·96	16·3	14·3	2·62	·91	3·47	·65	11½/12	0/7	146,880,000	1,614,000	71
December 24th, 1930	5·68	2·24	2·03	·96	·285	·14	·015	·01	·12	·76	17·7	15·4	2·47	·95	3·49	·78	11½/13	0/13	227,460,000	2,500,000	110
March 25th, 1931 ...	5·00	2·16	1·81	1·02	·33	·14	·015	·01	·18	·90	17·1	15·8	2·02	·82	2·80	·70	9½/13	0/13	208,800,000	2,295,000	101
Average	5·78	2·37	1·95	·85	·31	·135	·01	·015	·12	·91	16·9	15·6	2·56	·98	3·64	·83	44½/51	0/42	778,980,000	2,140,000	94
Average for year ending March 26th, 1930 ...	5·97	2·40	2·22	·81	·32	·145	Trace	·025	·11	·85	18·1	16·7	2·89	1·16	3·91	·97	39/50	0/40	823,140,000	2,261,000	100
Purification effected — Calculated on primary effluent		59 %				56 %															
Purification effected — Corresponding purification for year ending March 26th, 1930		60 %				55 %															
Purification effected — Calculated on raw sewage		79 %				79 %															
Purification effected — Corresponding purification for year ending March 26th, 1930		77 %				78 %															

Results expressed in parts per 100,000.

Table XV.

DAVYHULME WORKS.

TABLE XV.—SHOWING THE AMOUNT OF SUSPENDED SOLIDS CONTAINED IN THE SEWAGE, TANK EFFLUENTS, AND FILTRATES.

	RESULTS EXPRESSED IN PARTS PER 100,000								
	Average for the year ending March 25th, 1931			Average for the year ending March 26th, 1930			Average for the year ending March 27th, 1929		
	Mineral	Organic and volatile	Total	Mineral	Organic and volatile	Total	Mineral	Organic and volatile	Total
Sewage	8·1	14·9	23·0	8·6	15·5	24·1	9·3	16·4	25·7
Open septic tank effluent (East)	4·0	6·8	10·8	4·3	6·7	11·0	4·4	6·7	11·1
Series I. (Beds 13 to 52)	2·0	3·1	5·1	2·3	3·3	5·6	2·6	3·8	6·4
Do. II. (Beds 1A to 10)	1·7	2·8	4·5	2·1	3·0	5·1	2·4	3·9	6·3
Open septic tank effluent (West)	3·7	6·2	9·9	3·3	5·8	9·1	3·3	4·8	8·1
Series III. and IIIA. (Beds 53 to 92)	1·6	2·7	4·3	1·9	3·0	4·9	1·9	3·4	5·3
Unfiltered tank effluent	5·0	8·4	13·4	4·7	7·0	11·7	4·9	8·1	13·0
Second contact bed (No. 10A)...	1·0	1·4	2.4	1·2	1·4	2·6	1·1	1·9	3·0
Do. do. (No. 1)	1·0	1·3	2·3	1·0	1·3	2·3	1·0	1·6	2·6
Do. do. (Nos. 2 to 27 inclusive) ...	1·1	1·4	2·5	1·2	1·4	2·6	1·0	1·7	2·7
Do. do. (Nos. 32 to 39 inclusive) ...	1·1	1·5	2·6	1·3	1·4	2·7	1·1	1·8	2·9

TABLE XVI.—RESULTS OF EXAMINATION OF THE SHIP CANAL WATER ABOVE AND BELOW THE OUTFALL.

DATE	Four hours oxygen absorption at 26·7°C		Ammoniacal nitrogen		Albuminoid nitrogen		Chloride (in terms of Cl.)		INCUBATION TEST: 3 Minutes oxygen absorption: Before incubation		After incubation		Putrescibility		Percentage rise in the 3 minutes oxygen absorption test after incubation	
MONTH	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
April 1930	1·37	2·10	·45	·68	·09	·125	8·4	9·6	·43	·68	·50	·96	½/8	3½/8	—	—
May ,,	1·80	2·39	·65	·75	·115	·135	10·5	11·0	·70	·92	1·00	1·42	5½/7	6/7	—	—
June ,,	2·55	3·12	·95	1·14	·145	·155	12·7	13·5	1·05	1·39	1·82	2·69	6/7	7/7	—	—
July ,,	2·33	2·89	·84	1·06	·115	·14	11·5	12·0	·94	1·27	1·65	2·44	6/9	7/9	—	—
August ,,	1·33	1·76	·27	·33	·08	·11	4·5	5·5	·45	·65	·57	·65	½/3	½/3	—	—
September ,,	1·29	1·78	·46	·59	·09	·115	7·2	8·6	·45	·71	·62	·94	1½/8	3½/8	—	—
October ,,	1·03	1·64	·29	·47	·06	·10	5·9	7·6	·30	·58	·32	·76	0/8	½/8	—	—
November ,,	1·02	1·53	·22	·34	·055	·085	4·3	6·8	·29	·50	·33	·56	0/5	1/5	—	—
December ,,	1·47	1·90	·44	·51	·105	·115	5·9	6·5	·41	·61	·55	·68	1½/7	1½/7	—	—
January 1931	1·09	1·53	·33	·39	·105	·11	5·3	5·7	·30	·43	·40	·53	½/6	½/6	—	—
February ,,	·97	1·28	·27	·31	·05	·07	4·7	5·9	·27	·38	·27	·39	0/5	0/5	—	—
March ,,	1·42	2·28	·44	·76	·075	·14	9·1	11·1	·51	1·05	·57	1·14	0/6	2/6	—	—
Average	1·47	2·02	·47	·61	·09	·115	7·5	8·7	·51	·76	·72	1·10	22/79	33/79	41%	45%
Average for year ending:— March, 1930	1·57	2·09	·59	·74	·13	·14	9·6	10·9	·69	·99	·89	1·36	31½/79	39½/79	29%	38%
March, 1929	1·54	2·14	·55	·75	·13	·16	9·0	10·3	·64	·97	·86	1·37	34½/74	41½/74	33%	41%
,, 1928	1·23	1·69	·47	·62	·10	·13	7·1	8·1	·51	·76	·67	1·00	23/80	31½/80	31%	32%
,, 1927	1·33	1·73	·56	·71	·11	·14	7·9	9·0	·53	·76	·71	1·04	24/81	35½/81	35%	38%
,, 1926	1·47	1·79	·66	·79	·13	·145	8·3	9·3	·64	·81	·87	1·19	32½/85	38/85	36%	46%
,, 1925	1·33	1·60	·52	·62	·13	·14	6·7	7·7	·56	·73	·81	·97	38/95	40/95	46%	33%
,, 1924	1·47	1·67	·66	·78	·16	·17	7·6	9·3	·63	·76	·84	·94	2[illegible]½/86	20/86	34%	25%
,, 1923	1·59	1·80	·68	·81	·17	·19	7·7	9·4	·71	·83	·84	·94	26½/83	25/83	18%	14%

A=Sample taken above the outlet of effluent from the works. **B**=Sample taken below the outlet of effluent from the works.

Results expressed in parts per 100,000.

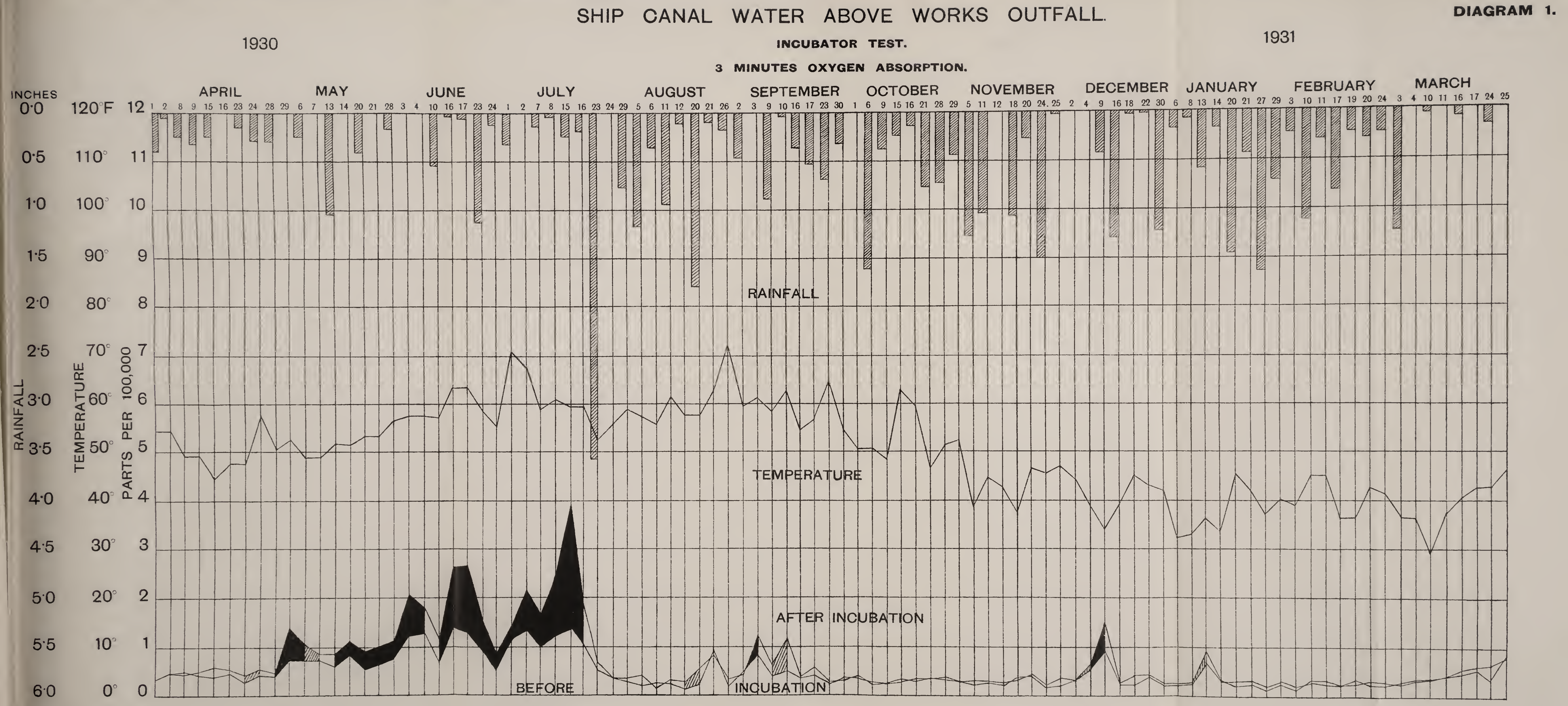
TABLE XVII.—COST OF SEWAGE DISPOSAL, 1896 to 1930.

Year ending	Maintenance charge		Capital charge		Total outlay on purification works to date	Total capital and maintenance charges		Per cent. purification of raw sewage		Average number of population connected to sewers
	Total per annum	Cost per head of population	Total per annum	Cost per head of population		Total per annum	Cost per head of population	As measured by the 4 hours oxygen absorption test	As measured by the albuminoid nitrogen test	
	£	Pence	£	Pence	£	£	Pence	Per cent.	Per cent.	
December, 1896	15,780	10·4	8,129	5·4	162,572	23,909	15·8	......	......	363,040
,, 1897	19,089	9·9	9,797	5·1	195,942	28,886	15·0	......	......	462,020
,, 1898	20,000	9·3	10,517	4·9	210,334	30,517	14·2	......	......	515,120
March, 1900	18,728	8·1	10,634	4·6	212,672	29,362	12·7	......	......	553,910
,, 1901	21,439	9·2	10,793	4·6	215,866	32,232	13·8	39	38	558,812
,, 1902	19,212	8·2	12,395	5·3	247,893	31,607	13·5	40	40	564,200
,, 1903	15,512	6·6	17,473	7·4	349,457	32,985	14·0	38	41	567,570
,, 1904	14,684	6·1	21,316	8·7	426,323	36,000	15·0	45	52	574,130
,, 1905	14,273	6·0	23,506	9·8	470,121	37,779	15·8	68	71	575,270
,, 1906	16,648	7·8	24,069	10·0	481,374	42,717	17·8	70	74	575,900
,, 1907	21,795	9·1	24,029	10·0	480,566	45,824	19·1	64	69	576,620
,, 1908	27,147	11·3	24,730	10·3	494,614	51,877	21·6	61	68	577,230
,, 1909	30,457	12·4	25,982	10·6	519,643	56,439	23·0	64	70	588,600
,, 1910	27,674	11·0	27,239	10·8	544,785	54,913	21·8	67	72	603,910
,, 1911	22,660	8·9	28,444	11·2	568,884	51,104	20·1	69	70	611,100
,, 1912	24,530	9·8	29,569	11·8	591,376	54,099	21·6	74	76	602,000*
,, 1913	28,730	11·4	29,928	11·9	598,567	58,658	23·3	74	76	605,000
,, 1914	31,634	12·3	30,540	11·9	610,794	62,174	24·2	77	78	616,000
,, 1915 (53 weeks)	32,347	11·4	30,832	10·8	616,637	63,179	22·2	71	71	682,000
,, 1916	30,871	9·8	30,857	9·8	617,149	61,728	19·6	71	72	755,000
,, 1917	26,818	8·5	31,121	9·9	622,425	57,939	18·4	68	71	755,000
,, 1918	30,798	9·6	31,121	9·7	622,425	61,919	19·3	62	63	768,000
,, 1919	34,954	11·0	31,121	9·8	622,425	66,075	20·8	58	61	764,000
,, 1920 (53 weeks)	61,805	19·4	31,683	9·9	633,676	93,488	29·3	54	60	765,000
,, 1921	92,595	28·8	31,840	9·9	636,805	124,435	38·7	51	55	770,500
,, 1922	97,298	31·5	32,088	10·3	641,764	129,386	41·9	54	59	741,600*
,, 1923	73,759	23·7	32,278	10·4	645,568	106,037	34·1	62	63	747,100
,, 1924	68,382	21·9	32,278	10·4	645,568	100,660	32·3	63	65	748,300
,, 1925	52,771	16·9	32,278	10·3	645,568	85,049	27·2	53	57	750,500
,, 1926 (53 weeks)	57,269	18·2	32,278	10·3	645,568	89,547	28·5	54	56	754,000
,, 1927	57,442	18·2	33,322	10·6	666,443	90,764	28·8	49	51	757,000
,, 1928	58,984	18·6	35,582	11·2	711,645	94,566	29·8	45	45	760,200
,, 1929	59,679	18·8	37,324	11·7	746,481	97,003	30·5	46	48	763,500
,, 1930	62,294	19·2	38,564	11·9	771,288	100,858	31·1	48	48	778,500‡
,, 1931	61,089	18·8	40,052	12·3	801,039	101,091	31·1	48	47	781,000

NOTE.—The capital charges given above include the cost of all land purchases at Davyhulme and Flixton. The annual charges have been computed by taking 5 per cent. of the total outlay to date.

* The estimation of the population connected to the sewers was revised in the light of the latest census returns.

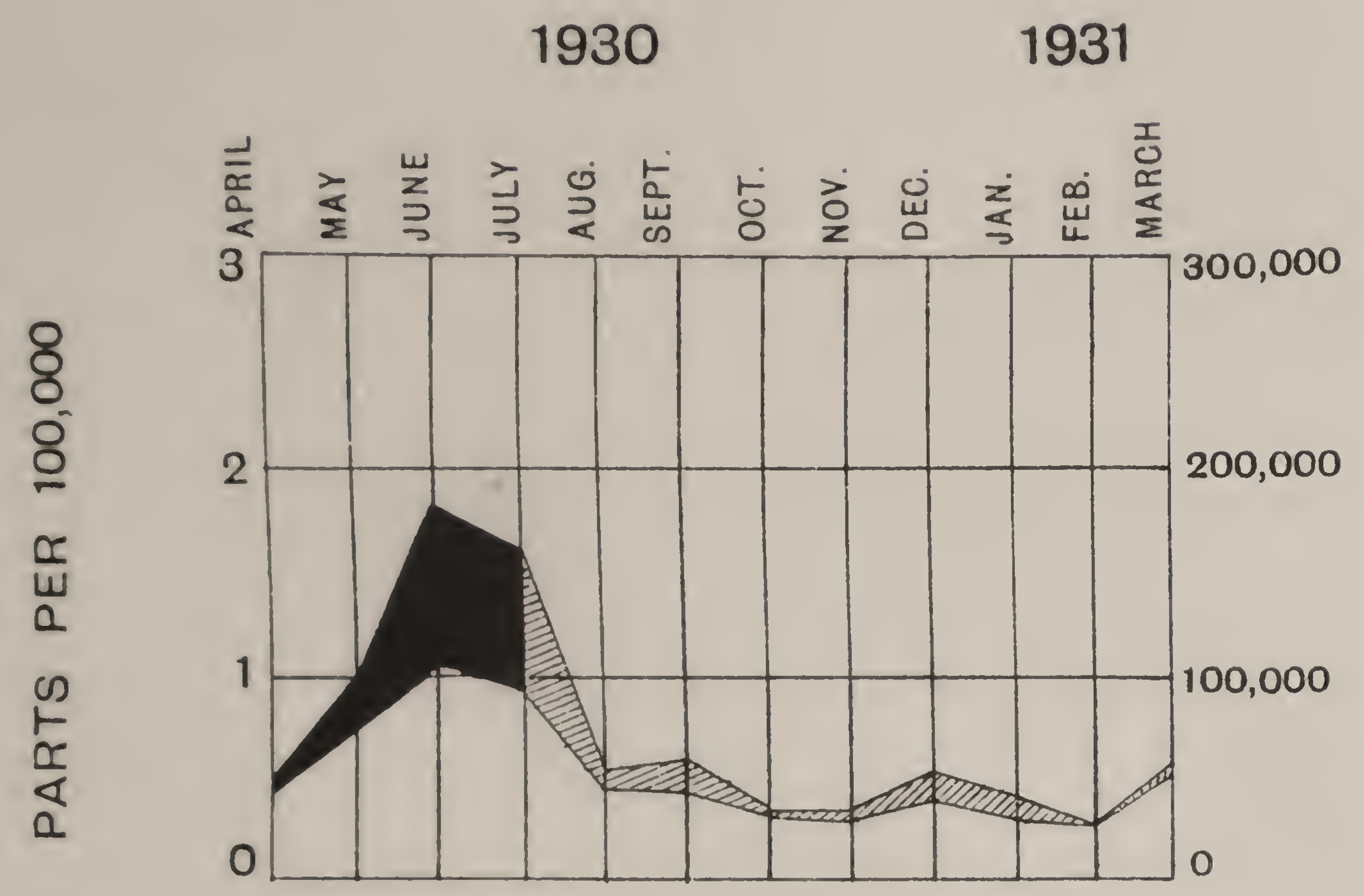
‡ Adjusted by reason of diversion of sewage from the Withington Works.


SHIP CANAL WATER ABOVE WORKS OUTFALL.
DIAGRAM 1.
1930
1931
INCUBATOR TEST.
3 MINUTES OXYGEN ABSORPTION.
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
INCHES
RAINFALL
TEMPERATURE
PARTS PER 100,000
RAINFALL
TEMPERATURE
AFTER INCUBATION
BEFORE
INCUBATION

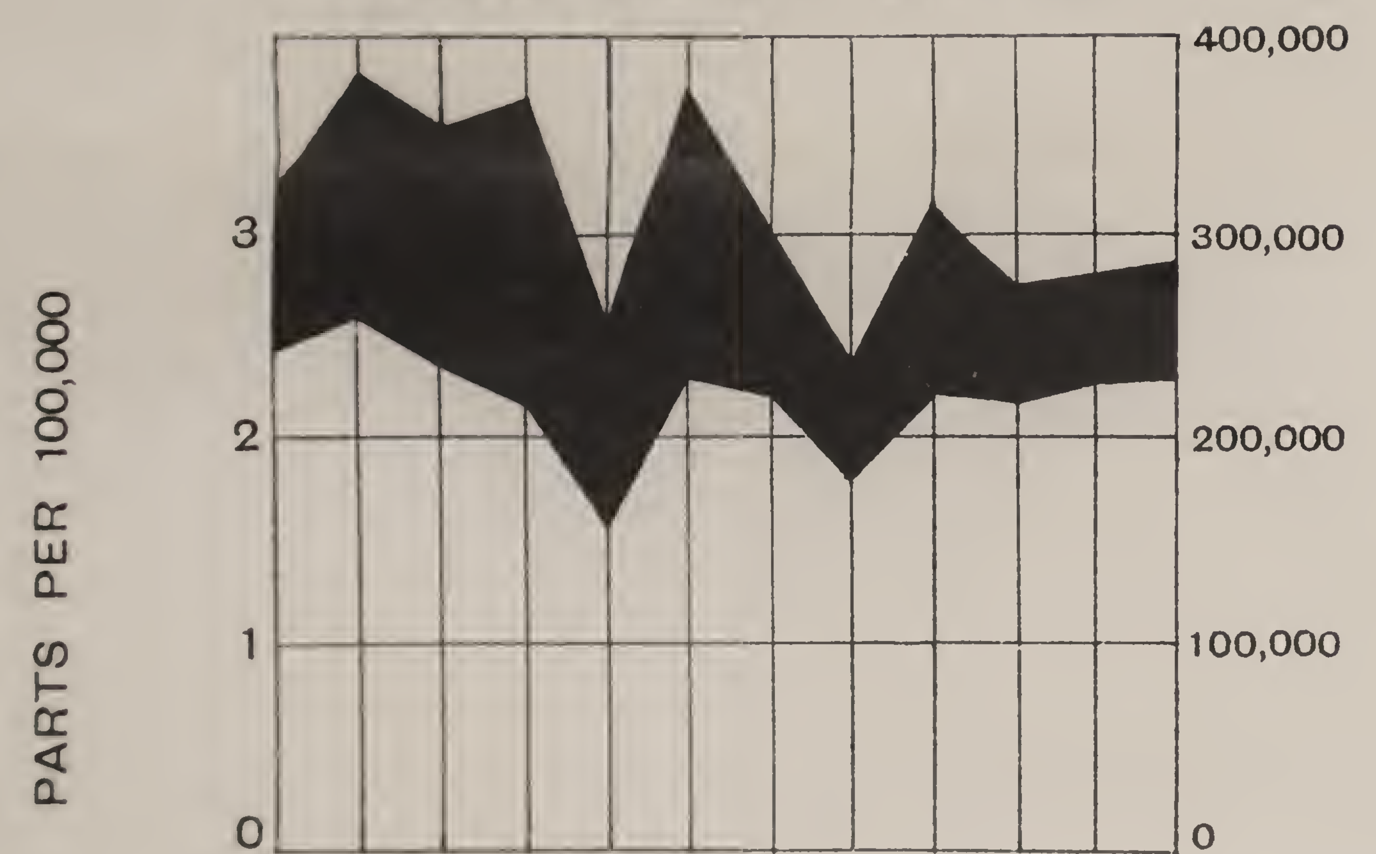
MONTHLY AVERAGES OF ANALYSES OF SHIP CANAL WATER TAKEN ABOVE AND BELOW WORKS OUTFALL, AND AVERAGE EFFLUENT FROM WORKS.

DIAGRAM 2.

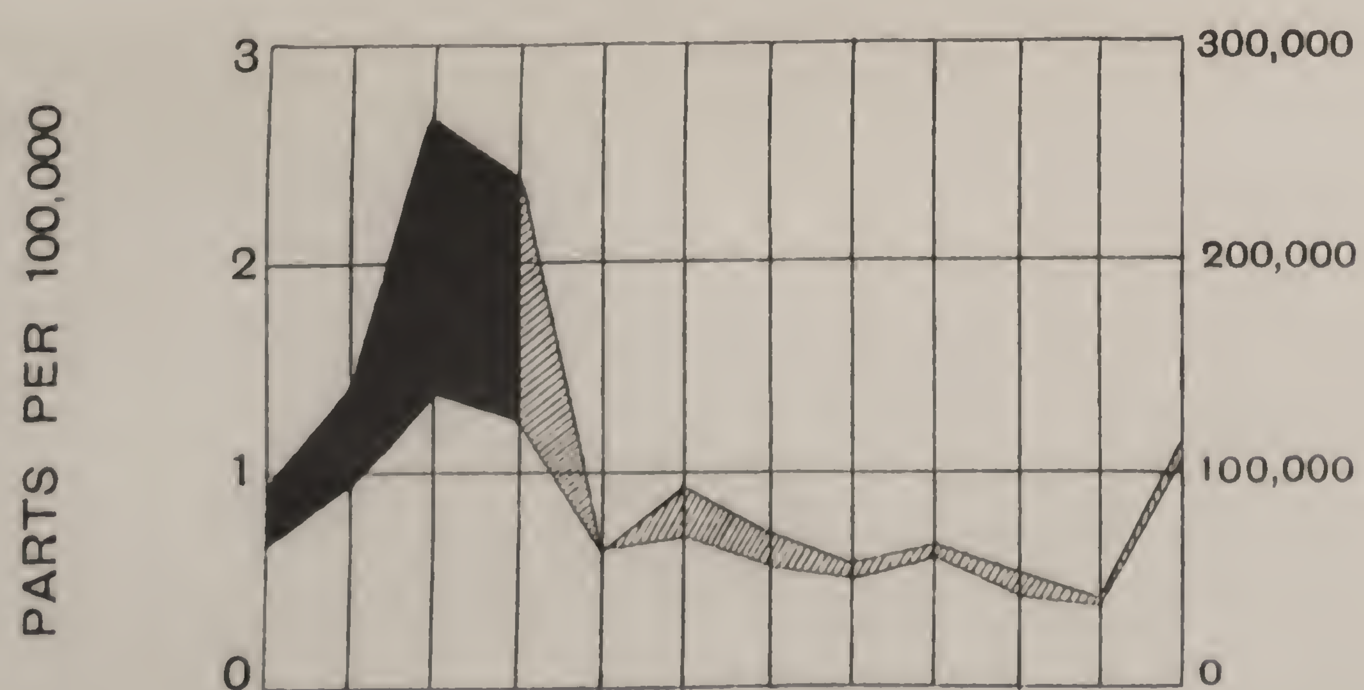
INCUBATOR TEST. **3 MINUTES OXYGEN ABSORPTION.**



ABOVE WORKS OUTFALL



AVERAGE EFFLUENT



BELOW WORKS OUTFALL

AVERAGE PER CENT. INCREASE AFTER INCUBATION